## \*\*\* 1AC

### 1AC—Warming Adv

**Contention One – CO2**

**Warming is real, anthropogenic, and reversible if we start mitigation now.**

**Nuccitelli 11** (Dana Nuccitelli is an environmental scientist at a private environmental consulting firm in the Sacramento, California area. He has a Bachelor's Degree in astrophysics from the University of California at Berkeley, and a Master's Degree in physics from the University of California at Davis. He has been researching climate science, economics, and solutions as a hobby since 2006, and has contributed to Skeptical Science since September, 2010., Updated 2011, Originally Posted 9/24/2010, “The Big Picture”, http://www.skepticalscience.com/big-picture.html)

Oftentimes we get bogged down discussing one of the many pieces of evidence behind man-made global warming, and in the process we can't see the forest from the trees. It's important to every so often take a step back and see how all of those trees comprise the forest as a whole. Skeptical Science provides an invaluable resource for examining each individual piece of climate evidence, so let's make use of these individual pieces to see how they form the big picture.

The Earth is Warming

We know **the planet is warming** from surface temperature stations and satellites measuring the temperature of the Earth's surface and lower atmosphere. We also have various tools, which have measured the warming of the Earth's oceans. Satellites have measured an energy imbalance at the top of the Earth's atmosphere. Glaciers, sea ice, and ice sheets are all receding. Sea levels are rising. Spring is arriving sooner each year. There's simply no doubt - the planet is warming (Figure 1).

Global Warming Continues

And yes, the warming is continuing. The 2000s were hotter than the 1990s, which were hotter than the 1980s, which were hotter than the 1970s. 2010 tied for the hottest year on record. The 12-month running average global temperature broke the record three times in 2010, according to NASA Goddard Institute for Space Studies (GISS) data. Sea levels are still rising, ice is still receding, spring is still coming earlier, there's still a planetary energy imbalance, etc. etc.

Contrary to what some would like us to believe, the planet has not magically stopped warming. Those who argue otherwise are confusing short-term noise with long-term global warming (Figure 2).

Foster and Rahmstorf (2011) showed that when we filter out the short-term effects of the sun, volcanoes, and El Niño cycles, the underlying man-made global warming trend becomes even more clear (Figure 3).

For as much as atmospheric temperatures are rising, the amount of energy being absorbed by the planet is even more striking when one looks into the deep oceans and the change in the global heat content (Figure 4).

Humans are Increasing Atmospheric Greenhouse Gases

The amount of greenhouse gases in the atmosphere - particularly carbon dioxide (CO2) - has been rising steadily over the past 150 years. There are a number of lines of evidence, which clearly demonstrate that this increase is due to human activities, primarily **burning fossil fuels**.

The most direct of evidence involves simple accounting. Humans are currently emitting approximately 30 billion tons of CO2 per year, and the amount in the atmosphere is increasing by about 15 billion tons per year. Our emissions have to go somewhere - half goes into the atmosphere, while the other half is absorbed by the oceans (which is causing another major problem - ocean acidification).

We also know the atmospheric increase is from burning fossil fuels because of the isotopic signature of the carbon in the atmosphere. Carbon comes in three different isotopes, and plants have a preference for the lighter isotopes. So if the fraction of lighter carbon isotopes in the atmosphere is increasing, we know the increase is due to burning plants and fossil fuels, and that is what scientists observe.

The fact that humans are responsible for the increase in atmospheric CO2 is settled science. The evidence is clear-cut.

Human Greenhouse Gases are Causing Global Warming

There is overwhelming evidence that humans are the dominant cause of the recent global warming, mainly due to our greenhouse gas emissions. Based on fundamental physics and math, we can quantify the amount of warming human activity is causing, and verify that we're responsible for essentially all of the global warming over the past 3 decades. The aforementioned Foster and Rahmstorf (2011) found a 0.16°C per decade warming trend since 1979 after filtering out the short-term noise.

In fact we expect human greenhouse gas emissions to cause more warming than we've thus far seen, due to the thermal inertia of the oceans (the time it takes to heat them). Human aerosol emissions are also offsetting a significant amount of the warming by causing global dimming. Huber and Knutti (2011) found that human greenhouse gas emissions have caused 66% more global warming than has been observed since the 1950s, because the cooling effect of human aerosol emissions have offset about 44% of that warming. They found that overall, human effects are responsible for approximately 100% of the observed global warming over the past 60 years (Figure 5).

There are also numerous 'fingerprints' which we would expect to see from an increased greenhouse effect (i.e. more warming at night, at higher latitudes, upper atmosphere cooling) that we have indeed observed (Figure 6).

Climate **models have projected** the ensuing global warming to a high level of accuracy, verifying that we have a good understanding of the fundamental physics behind climate change.

Sometimes people ask "what would it take to falsify the man-made global warming theory?". Well, basically it would require that our fundamental understanding of physics be wrong, because that's what the theory is based on. This fundamental physics has been scrutinized through scientific experiments for decades to centuries.

The Warming will Continue

We also know that if we continue to emit large amounts of greenhouse gases, the planet will continue to warm. We know that the climate sensitivity to a doubling of atmospheric CO2 from the pre-industrial level of 280 parts per million by volume (ppmv) to 560 ppmv (we're currently at 390 ppmv) will cause 2–4.5°C of warming. And we're headed for 560 ppmv in the mid-to-late 21st century if we continue business-as-usual emissions.

The precise sensitivity of the climate to increasing CO2 is still fairly uncertain: 2–4.5°C is a fairly wide range of likely values. However, even if we're lucky and the climate sensitivity is just 2°C for doubled atmospheric CO2, if we continue on our current emissions path, we will commit ourselves to that amount of warming (2°C above pre-industrial levels) within the next 75 years.

The Net Result will be Bad

There will be some positive results of this continued warming. For example, an open Northwest Passage, enhanced growth for some plants and improved agriculture at high latitudes (though this will require use of more fertilizers), etc. However, the negatives will almost certainly outweigh the positives, by a long shot. We're talking decreased biodiversity, water shortages, increasing heat waves (both in frequency and intensity), decreased crop yields due to these impacts, damage to infrastructure, displacement of millions of people, etc.

Arguments to the contrary are superficial

One thing I've found in reading skeptic criticisms of climate science is that they're consistently superficial. For example, the criticisms of James Hansen's 1988 global warming projections never go beyond "he was wrong," when in reality it's important to evaluate what caused the discrepancy between his projections and actual climate changes, and what we can learn from this. And those who argue that "it's the Sun" fail to comprehend that we understand the major mechanisms by which the Sun influences the global climate, and that they cannot explain the current global warming trend. And those who argue "it's just a natural cycle" can never seem to identify exactly which natural cycle can explain the current warming, nor can they explain how our understanding of the fundamental climate physics is wrong.

There are legitimate unresolved questions

Much ado is made out of the expression "the science is settled." The science is settled in terms of knowing that the planet is warming rapidly, and that humans are the dominant cause.

There are certainly unresolved issues. As noted above, there's a big difference between a 2°C and a 4.5°C warming for a doubling of atmospheric CO2, and it's an important question to resolve, because we need to know how fast the planet will warm in order to know how fast we need to reduce our greenhouse gas emissions. There are significant uncertainties in some feedbacks which play into this question. For example, will clouds act as a net positive feedback (by trapping more heat, causing more warming) or negative feedback (by reflecting more sunlight, causing a cooling effect) as the planet continues to warm? And exactly how much global warming is being offset by human aerosol emissions?

These are the sorts of questions we should be debating, and the issues that most climate scientists are investigating. Unfortunately there is a there is a very vocal contingent of people determined to continue arguing the resolved questions for which the science has already been settled. And when climate scientists are forced to respond to the constant propagation of misinformation on these settled issues, it just detracts from our investigation of the legitimate, unresolved, important questions.

Smart Risk Management Means Taking Action

People are usually very conservative when it comes to risk management. Some of us buy fire insurance for our homes when the risk of a house fire is less than 1%, for example. When it comes to important objects like cars and homes, we would rather be **safe than sorry**.

But there is arguably no more important object than the global climate. We rely on the climate for our basic requirements, like having enough accessible food and water. Prudent risk management in this case is clear. The scientific evidence discussed above shows indisputably that there is a risk that we are headed towards very harmful climate change. There are uncertainties as to how harmful the consequences will be, but uncertainty is not a valid reason for inaction. There's very high uncertainty whether I'll ever be in a car accident, but it would be foolish of me not to prepare for that possibility by purchasing auto insurance. Moreover, **uncertainty cuts both ways**, and it's just as likely that the consequences will be worse than we expect as it is that the consequences won't be very bad.

We Can Solve the Problem

The good news is that we have the tools we need to mitigate the risk posed by climate change. A number of plans have been put forth to achieve the necessary greenhouse gas emissions cuts (i.e. here and here and here). We already have all the technology we need.

Opponents often argue that mitigating global warming will hurt the economy, but the opposite is true. Those who argue that reducing emissions will be too expensive ignore the costs of climate change - economic studies have consistently shown that mitigation is several times less costly than trying to adapt to climate change (Figure 7).

The Big Picture

The big picture is that we know the planet is warming, humans are causing it, there is a substantial risk to continuing on our current path, but we don't know exactly how large the risk is. However, uncertainty regarding the magnitude of the risk is not an excuse to ignore it. We also know that if we continue on a business-as-usual path, the risk of catastrophic consequences is very high. In fact, the larger the uncertainty, the greater the potential for the exceptionally high-risk scenario to become reality. We need to continue to decrease the uncertainty, but it's also critical to acknowledge what we know and what questions have been resolved, and that taking no action is not an option. The good news is that we know how to solve the problem, and that doing so will minimize the impact not only on the climate, but also on the economy.

The bottom line is that from every perspective - scientific, risk management, economic, etc. - there is no reason not to immediately take serious action to mitigate climate change, and failing to do so would be exceptionally foolish.

**Reducing CO2 is key. We are reaching a tipping point.**

**Hansen et al 10** – Director of NASA/Goddard Institute for Space Studies [Dr. James Hansen, Dr. Makiko Sato (Physicist @ NASA/Goddard Institute for Space Studies), Dr. Pushker Kharecha (Researcher of earch sciences and astrobiology @ NASA/Goddard Institute for Space Studies), Dr. David Beerling (Professor of Animal and Plant Sciences @ University of Sheffield), Dr. Robert Berner (Professor Geology and Geophysics @ Yale University), Valerie Masson-Delmotte (Lab. Des Sciences du Climat et l’Environnement/Institut Pierre Simon Laplace, CEA-CNRS-Universite de Versailles Saint-Quentin en Yvelines), Dr. Mark Pagani (Professor of paleoceanography and paleoclimatology @ Yale University), Dr. Maureen Raymo (Paleoclimatologist/marine geologist @ Boston University), Dr. Dana L. Royer (Professor of Earth and Environmental Sciences @ Wesleyan University) & Dr. James C. Zachos ( Professor of Earth & Planetary Sciences @ University of California – Santa Cruzo) “Target atmospheric CO2: Where should humanity aim?” Open Atmos. Sci. J. (2008), vol. 2, pp. 217-231

Realization that today’s climate is far out of equilibrium with current climate forcings raises the specter of ‘tipping points’, the concept that climate can reach a point where, without additional forcing, rapid changes proceed practically out of our control [2, 7, 63, 64]. Arctic sea ice and the West Antarctic Ice Sheet are examples of potential tipping points. Arctic sea ice loss is magnified by the positive feedback of increased absorption of sunlight as global warming initiates sea ice retreat [65]. West Antarctic ice loss can be accelerated by several feedbacks, once ice loss is substantial [39].

We define: (1) the tipping level, the global climate forcing that, if long maintained, gives rise to a specific consequence, and (2) the point of no return, a climate state beyond which the consequence is inevitable, even if climate forcings are reduced. A point of no return can be avoided, even if the tipping level is temporarily exceeded. Ocean and ice sheet inertia permit overshoot, provided the climate forcing is returned below the tipping level before initiating irreversible dynamic change.

Points of no return are inherently difficult to define, because the dynamical problems are nonlinear. Existing models are more lethargic than the real world for phenomena now unfolding, including changes of sea ice [65], ice streams [66], ice shelves [36], and expansion of the subtropics [67, 68].

The tipping level is easier to assess, because the paleoclimate quasi-equilibrium response to known climate forcing is relevant. The tipping level is a measure of the long-term climate forcing that humanity must aim to stay beneath to avoid large climate impacts. The tipping level does not define the magnitude or period of tolerable overshoot. However, if overshoot is in place for centuries, the thermal perturbation will so penetrate the ocean [10] that recovery without dramatic effects, such as ice sheet disintegration, becomes unlikely.

4.2. Target CO2

Combined, GHGs other than CO2 cause climate forcing comparable to that of CO2 [2, 6], but growth of non-CO2 GHGs is falling below IPCC [2] scenarios. Thus total GHG climate forcing change is now determined mainly by CO2 [69]. Coincidentally, CO2 forcing is similar to the net human-made forcing, because non-CO2 GHGs tend to offset negative aerosol forcing [2, 5].

Thus we take future CO2 change as approximating the net human-made forcing change, with two caveats. First, special effort to reduce non-CO2 GHGs could alleviate the CO2 requirement, allowing up to about +25 ppm CO2 for the same climate effect, while resurgent growth of nonCO2 GHGs could reduce allowed CO2 a similar amount [6]. Second, reduction of human-made aerosols, which have a net cooling effect, could force stricter GHG requirements. However, an emphasis on reducing black soot could largely off-set reductions of high albedo aerosols [20].

Our estimated history of CO2 through the Cenozoic Era provides a sobering perspective for assessing an appropriate target for future CO2 levels. A CO2 amount of order 450 ppm or larger, if long maintained, would push Earth toward the ice-free state. Although ocean and ice sheet inertia limit the rate of climate change, such a CO2 level likely would cause the passing of climate tipping points and initiate dynamic responses that could be out of humanity’s control.

**Extinction**

**Brandenberg 99** (John & Monica Paxson, Visiting Prof. Researcher @ Florida Space Institute, Physicist Ph.D., Science Writer, Dead Mars Dying Earth, Pg 232-233)

The ozone hole expands, driven by a monstrous synergy with global warming that puts more catalytic ice crystals into the stratosphere, but this affects the far north and south and not the major nations’ heartlands. The seas rise, the tropics roast but the media networks no longer cover it. The Amazon rainforest becomes the Amazon desert. Oxygen levels fall, but profits rise for those who can provide it in bottles. An equatorial high-pressure zone forms, forcing drought in central Africa and Brazil, the Nile dries up and the monsoons fail. Then inevitably, at some unlucky point in time, a major unexpected event occurs—a major volcanic eruption, a sudden and dramatic shift in ocean circulation or a large asteroid impact (those who think freakish accidents do not occur have paid little attention to life or Mars), or a nuclear war that starts between Pakistan and India and escalates to involve China and Russia . . . Suddenly the gradual climb in global temperatures goes on a mad excursion as the oceans warm and release large amounts of dissolved carbon dioxide from their lower depths into the atmosphere. Oxygen levels go down precipitously as oxygen replaces lost oceanic carbon dioxide. Asthma cases double and then double again. Now a third of the world fears breathing. As the oceans dump carbon dioxide, the greenhouse effect increases, which further warms the oceans, causing them to dump even more carbon. Because of the heat, plants die and burn in enormous fires, which release more carbon dioxide, and the oceans evaporate, adding more water vapor to the greenhouse. Soon, we are in what is termed a runaway greenhouse effect, as happened to Venus eons ago. The last two surviving scientists inevitably argue, one telling the other, “See! I told you the missing sink was in the ocean!” Earth, as we know it, dies. After this Venusian excursion in temperatures, the oxygen disappears into the soil, the oceans evaporate and are lost and the dead Earth loses its ozone layer completely. Earth is too far from the Sun for it to be the second Venus for long. Its atmosphere is slowly lost—as is its water—because of ultraviolet bombardment breaking up all the molecules apart from carbon dioxide. As the atmosphere becomes thin, the Earth becomes colder. For a short while temperatures are nearly normal, but the ultraviolet sears any life that tries to make a comeback. The carbon dioxide thins out to form a thin veneer with a few wispy clouds and dust devils. Earth becomes the second Mars—red, desolate, with perhaps a few hardy microbes surviving.

**Geologic history is on our side**

**Bushnell 10** - Chief scientist at the NASA Langley Research Center [Dennis Bushnell (MS in mechanical engineering. He won the Lawrence A. Sperry Award, AIAA Fluid and Plasma Dynamics Award, the AIAA Dryden Lectureship, and is the recipient of many NASA Medals for outstanding Scientific Achievement and Leadership.) “Conquering Climate Change,” The Futurist, May-June, 2010

Carbon-dioxide levels are now greater than at any time in the past 650,000 years, according to data gathered from examining ice cores. These increases in CO2 correspond to estimates of man-made uses of fossil carbon fuels such as coal, petroleum, and natural gas. The global climate computations, as reported by the ongoing Intergovernmental Panel on Climate Change (IPCC) studies, indicate that such man-made CO2 sources could be responsible for observed climate changes such as temperature increases, loss of ice coverage, and ocean acidification. Admittedly, the less than satisfactory state of knowledge regarding the effects of aerosol and other issues makes the global climate computations less than fully accurate, but we must take this issue very seriously.

I believe we should act in accordance with the precautionary principle: When an activity raises threats of harm to human health or the environment, precautionary measures become obligatory, even if some cause-and-effect relationships are not fully established scientifically. As paleontologist Peter Ward discussed in his book Under a Green Sky, several “warming events” have radically altered the life on this planet throughout geologic history. Among the most significant of these was the Permian extinction, which took place some 250 million years ago. This event resulted in a decimation of animal life, leading many scientists to refer to it as the Great Dying. The Permian extinction is thought to have been caused by a sudden increase in CO2 from Siberian volcanoes. The amount of CO2 we’re releasing into the atmosphere today, through human activity, is 100 times greater than what came out of those volcanoes.

During the Permian extinction, a number of chain reaction events, or “positive feedbacks,” resulted in oxygen-depleted oceans, enabling overgrowth of certain bacteria, producing copious amounts of hydrogen sulfide, making the atmosphere toxic, and decimating the ozone layer, all producing species die-off. The positive feedbacks not yet fully included in the IPCC projections include the release of the massive amounts of fossil methane, some 20 times worse than CO2 as an accelerator of warming, fossil CO2 from the tundra and oceans, reduced oceanic CO2 uptake due to higher temperatures, acidification and algae changes, changes in the earth’s ability to reflect the sun’s light back into space due to loss of glacier ice, changes in land use, and extensive water evaporation (a greenhouse gas) from temperature increases.

The additional effects of these feedbacks increase the projections from a 4°C–6°C temperature rise by 2100 to a 10°C–12°C rise, according to some estimates. At those temperatures, beyond 2100, essentially all the ice would melt and the ocean would rise by as much as 75 meters, flooding the homes of one-third of the global population. Between now and then, ocean methane hydrate release could cause major tidal waves, and glacier melting could affect major rivers upon which a large percentage of the population depends. We’ll see increases in flooding, storms, disease, droughts, species extinctions, ocean acidification, and a litany of other impacts, all as a consequence of man-made climate change. Arctic ice melting, CO2 increases, and ocean warming are all occurring much faster than previous IPCC forecasts, so, as dire as the forecasts sound, they’re actually conservative. Pg. 7-8 //1ac

**The difference between total extinction and near extinction is infinite potential.**

**Matheny 7** (Jason, Ph.D. Candidate in the Department of Health Policy and Management at the Bloomberg School of Public Health at Johns Hopkins University, *Reducing the Risk of Human Extinction*, Risk Analysis, Volume 27, Number 5, Available Online at http://www.upmc-biosecurity.org/website/resources/publications/2007\_orig-articles/2007-10-15-reducingrisk.html)

We may be poorly equipped to recognize or plan for extinction risks (Yudkowsky, 2007). We may not be good at grasping the significance of very large numbers (catastrophic outcomes) or very small numbers (probabilities) over large timeframes. We struggle with estimating the probabilities of rare or unprecedented events (Kunreuther et al., 2001). Policymakers may not plan far beyond current political administrations and rarely do risk assessments value the existence of future generations.18 We may unjustifiably discount the value of future lives. Finally, extinction risks are market failures where an individual enjoys no perceptible benefit from his or her investment in risk reduction. Human survival may thus be a good requiring deliberate policies to protect. It might be feared that consideration of extinction risks would lead to a reductio ad absurdum: we ought to invest all our resources in asteroid defense or nuclear disarmament, instead of AIDS, pollution, world hunger, or other problems we face today. On the contrary, programs that create a healthy and content global population are likely to reduce the probability of global war or catastrophic terrorism. They should thus be seen as an essential part of a portfolio of risk-reducing projects.Discussing the risks of “nuclear winter,” Carl Sagan (1983) wrote: Some have argued that the difference between the deaths of several hundred million people in a nuclear war (as has been thought until recently to be a reasonable upper limit) and the death of every person on Earth (as now seems possible) is only a matter of one order of magnitude. For me, the difference is considerably greater. Restricting our attention only to those who die as a consequence of the war conceals its full impact. If we are required to calibrate extinction in numerical terms, I would be sure to include the number of people in future generations who would not be born. A nuclear war imperils all of our descendants, for as long as there will be humans. Even if the population remains static, with an average lifetime of the order of 100 years, over a typical time period for the biological evolution of a successful species (roughly ten million years), we are talking about some **500 trillion people** yet to come. By this criterion, the stakes are **one million times greater** for extinction than for the more modest nuclear wars that kill “only” hundreds of millions of people. There are many other possible measures of the potential loss—including culture and science, the evolutionary history of the planet, and the significance of the lives of all of our ancestors who contributed to the future of their descendants. Extinction is the undoing of the human enterprise. In a similar vein, the philosopher Derek Parfit (1984) wrote: I believe that if we destroy mankind, as we now can, this outcome will be much worse than most people think. Compare three outcomes:

1. Peace

2. A nuclear war that kills 99% of the world’s existing population

3. A nuclear war that kills 100%

2 would be worse than 1, and 3 would be worse than 2. Which is the greater of these two differences? Most people believe that the greater difference is between 1 and 2. I believe that the difference between 2 and 3 is very much greater.... The Earth will remain habitable for at least another billion years. Civilization began only a few thousand years ago. If we do not destroy mankind, these thousand years may be only a **tiny fraction** of the whole of civilized human history. The difference between 2 and 3 may thus be the difference between this tiny fraction and all of the rest of this history. If we compare this possible history to a day, what has occurred so far is only a **fraction of a second**. Human extinction in the next few centuries could reduce the number of future generations by thousands or more. We take extraordinary measures to protect some endangered species from extinction. It might be reasonable to take extraordinary measures to protect humanity from the same.19 To decide whether this is so requires more discussion of the methodological problems mentioned here, as well as research on the extinction risks we face and the costs of mitigating them.20

**Nuclear power solves.**

**SMRs are the only solution that addresses the magnitude of warming before it’s too late.**

**Palley 11 (**Reese Palley, The London School of Economics, 2011, The Answer: Why Only Inherently Safe, Mini Nuclear Power Plans Can Save Our World, p. 186-90)

The central investigation of this book has been directed at the scale of the nuclear industry. The book has argued that all anthropogenic challenges that put in question **continued human existence** on Earth are a **matter of scale**. It was nature’s unanticipated success with her human experiment, the evolutionary choice of brains over brawn, setting in motion the underlying scale problems that opened our Pandora’s box of calamities. The history of man on Earth can best be viewed as a race between population and resources in which, for some millennia, population expansion leads and the Earth’s resources have been straining to catch up. When population bloomed from 100 million brainy humans to a billion, the problems of scale emerged as the price we had to pay for success as a species. The conversion of forests to agriculture, responding to the need to feed a burgeoning population, initiated the emerging problem of scale. The elimination of oxygen-emitting forests was mitigated to a large measure in the beginning of our population growth by the slow rate of change of the deforestation, which allowed an absorbable increase of CO2 in the atmosphere. Natural processes, such as the ability of the oceans to take up CO2, tamped down global warming. But as the scale of the release of warming gases exploded a few hundred years ago, our remaining forests and our seas, our first line of defense against CO2 imbalance, could not cope and the level of CO2 has risen alarmingly each year since 1800. When human population climbed from a billion to six billion and these six billion reveled in the enormous energy content of coal, the scenario for **disaster on a global scale** came into play. The impact of the loss of forest paled in comparison to the havoc that the use of fossil fuels represented. In a world that was hungry for energy and, not incidentally, living on a Malthusian edge of food supply, coal burst upon us as manna from heaven. Coal was everywhere, easy to mine, and in enormous, almost unending supply It generated the cheap heat needed to run the engines of early industrialization. An unintended Faustian bargain was struck. The immediate cost of coal in the cities, dirt and pollution, were not out of sync with what urban man had lived with for centuries. It was beyond the science and the understanding of the time that burning vast millennial coal deposits would do little more than discommode the proximate few and benefit many. Again it was not the burning, it was **the scale** of the burning that dumped billions of tons of CO2 into the atmosphere. We are now presented with a horrendous invoice that must be paid if we are to **survive** in anywhere near the comfort to which we have become accustomed. It has been the intent of this book to argue that the **scale of the warming catastrophe** must be viewed primarily in terms of the continuing flow of CO2 into the atmosphere. Every possible source of CO2, no matter how small, must be identified and interdicted, since every fourth molecule of the gas will remain with us as a climate moderator for thousands of years. What we find is that all of the sources of energy including so-called green energy are CO2-culpable and that each, in spite of claims to the contrary, adds its tiny mite or enormous mass to the climate changes looming in man’s future. The book argues that the scale of the consumption of fossil fuels is clearly unsustainable and, more to the point, that the feeble attempts to restrict CO2 production are little more than a glossing over of the problem. Capping but not ending production of greenhouse gases only magnifies the unthinkable future costs of bringing the level of CO2 and other greenhouse gases back into balance. Logic dictates that merely limiting greenhouse gases pushes possible solutions farther and farther into the future and does little to mitigate the difficulties that will arise in the near future. Logic dictates that our reasonably comfortable survival depends on the immediate and total cessation of increases to parts per million of CO2 in the air. Logic dictates that if we are to continue to enjoy the level of comfort, wealth, and ease afforded us since the beginning of the twentieth century we must not only halt the increase but commence the actual decrease of warming gases at work in the atmosphere. That conclusion brings the book to the problems and the solutions inherent in nuclear power, the **only energy source** that can guarantee us a reasonable future that might be resistant to CO2 warming. Here the argument returns once again to the problem of scale of nuclear reactors, especially as the size of these reactors is related to the brief time left to us to get a grip on calamitous climate changes. The beginnings of nuclear energy lay in the demands of war. The battle between good and evil characterized by the Second World War gave hurried birth to a discovery that had the inherent power to both destroy and salvage. The power to destroy required plutonium on an enormous scale, which was projected forward into the postwar development of civilian reactors. The demand for scarce plutonium for the bombs of the cold war defined the type of reactors that were being developed. These were the breeder reactors, which spewed out plutonium measured in tons that had previously been available only in ounces, and would continue to do so when the wartime need was far behind us. What was once precious, rare, and desirable has become dangerous nuclear waste, and the imperfectly perceived scale of the waste problem has seriously inhibited the logical growth and development of nuclear power. By some unthinkable universal coincidence, nuclear power became available to man for war at the same time that it could prove to be the solution to man’s greatest peacetime challenge. But the gigawatt nuclear power plants that emerged from the war had within them the seeds of their own severe limitation. The scale of the risks, real and imagined, grew exponentially as the scale of energy output grew only linearly. These risks, some merely perceived, some dangerously real and some financial, have conspired to restrict the enormous expansion of nuclear power that is needed to quickly replace our present consumption of energy from fossil fuels. The present rate of replacement of fossil with nuclear sources is at a pace that will have little impact on ultimately dealing with the CO2 imbalance. This slow rate of change is compounded of public fears, bureaucratic regulatory mechanisms resistant to novel solutions, and a private capital market that is unable to conjure with the imagined and real risks of the huge gigawatt reactors that dominate the industry. It is a Gordian knot that cannot be unraveled but which can only be cut by a political sword that, alas, still lacks the edge to do the job. By another rare act of cosmic fortuity, there is a parallel existing nuclear technology that, barring political interference, is capable of addressing the scale problems inherent in gigawatt reactors. From the beginning of the nuclear era, researchers such as Weinberg and Wigner and Teller developed small, inherently safe nuclear reactors that did not breed plutonium. This was reason enough for the military, balancing urgent demands on research and development budgets, to consign the concept of “smaller and safer is better” to dusty shelves in our national science attic. This book has argued that small reactors, that produce a tenth of the energy of the giants also generate inordinately less of the risk that inhibits growth of the industry. Construction of small reactors is a fraction of the cost of construction of gigawatt reactors. Thus the number of years that scarce capital is tied up and at risk is substantially reduced. The book argues that a 100 MWe reactor88 is a much bigger hardware bargain than a gigawatt reactor, which, from start to output, can cost $15 billion. It is not only the hardware costs that contribute to the devilish details of risk. The problem is the inability of the market to accurately or even approximately estimate the real cost of the capital that would be tied up for over a decade in a project that, through technological advancements, could be obsolete before it ever joins the grid.

**Nuclear’s inevitable globally but won’t solve warming until the US develops SMR’s**

**Shellenberger 12** – et al and Ted Nordhaus—co-founders of American Environics and the Breakthrough Institute a think tank that works on energy and climate change – AND – Jesse Jenkins-Director of Energy and Climate Policy, the Breakthrough Institute (Michael, Why We Need Radical Innovation to Make New Nuclear Energy Cheap, 9/11, thebreakthrough.org/index.php/programs/energy-and-climate/new-nukes/)

Arguably, the biggest impact of Fukushima on the nuclear debate, ironically, has been to force a growing number of pro-nuclear environmentalists out of the closet, including us. The reaction to the accident by anti-nuclear campaigners and many Western publics put a fine point on the gross misperception of risk that informs so much anti-nuclear fear. **Nuclear remains the only proven technology capable of reliably generating zero-carbon energy at a scale that can have any impact on global warming**. Climate change -- and, for that matter, the enormous present-day health risks associated with burning coal, oil, and gas -- simply dwarf any legitimate risk associated with the operation of nuclear power plants. **About 100,000 people die every year due to exposure to air pollutants from the burning of coal**. By contrast, about 4,000 people have died from nuclear energy -- ever -- almost entirely due to Chernobyl.¶ But rather than simply lecturing our fellow environmentalists about their misplaced priorities, and how profoundly inadequate present-day renewables are as substitutes for fossil energy, we would do better to take seriously the real obstacles standing in the way of a serious nuclear renaissance. Many of these obstacles have nothing to do with the fear-mongering of the anti-nuclear movement or, for that matter, the regulatory hurdles imposed by the U.S. Nuclear Regulatory Commission and similar agencies around the world.¶ As long as nuclear technology is characterized by enormous upfront capital costs, it is likely to remain just a hedge against overdependence on lower-cost coal and gas, **not the wholesale replacement it needs to be to make a serious dent in climate change**. Developing countries need large plants capable of bringing large amounts of new power to their fast-growing economies. But they also need power to be cheap. So long as coal remains the cheapest source of electricity in the developing world, it is likely to remain king.¶ The most worrying threat to the future of nuclear isn't the political fallout from Fukushima -- it's economic reality. Even as new nuclear plants are built in the developing world, old plants are being retired in the developed world. For example, Germany's plan to phase-out nuclear simply relies on allowing existing plants to be shut down when they reach the ends of their lifetime. Given the size and cost of new conventional plants today, those plants are unlikely to be replaced with new ones. As such, the combined political and economic constraints associated with current nuclear energy technologies mean that nuclear energy's share of global energy generation is unlikely to grow in the coming decades, as global energy demand is likely to increase faster than new plants can be deployed.¶ To move the needle on nuclear energy to the point that it might actually be capable of displacing fossil fuels, we'll need **new nuclear technologies that are cheaper and smaller**. Today, there are a range of nascent, smaller nuclear power plant designs, some of them modifications of the current light-water reactor technologies used on submarines, and others, like thorium fuel and fast breeder reactors, which are based on entirely different nuclear fission technologies. **Smaller, modular reactors can be built much faster and cheaper than traditional large-scale nuclear power plants**. Next-generation nuclear reactors are designed to be incapable of melting down, produce drastically less radioactive waste, make it very difficult or impossible to produce weapons grade material, useless water, and require less maintenance.¶ Most of these designs still face substantial technical hurdles before they will be ready for commercial demonstration. That means a great deal of research and innovation will be necessary to make these next generation plants viable and capable of displacing coal and gas. The United States could be a leader on developing these technologies, but unfortunately U.S. nuclear policy remains mostly stuck in the past. Rather than creating new solutions, efforts to restart the U.S. nuclear industry have mostly focused on encouraging utilities to build the next generation of large, light-water reactors with loan guarantees and various other subsidies and regulatory fixes. With a few exceptions, this is largely true elsewhere around the world as well.¶ Nuclear has enjoyed bipartisan support in Congress for more than 60 years, but the enthusiasm is running out. The Obama administration deserves credit for authorizing funding for two small modular reactors, which will be built at the Savannah River site in South Carolina. But a much more sweeping reform of U.S. nuclear energy policy is required. At present, the Nuclear Regulatory Commission has little institutional knowledge of anything other than light-water reactors and virtually no capability to review or regulate alternative designs. This **affects nuclear innovation in other countries** as well, **since the NRC remains, despite its many critics, the global gold standard for thorough regulation of nuclear energy.** Most **other countries follow the NRC's lead when it comes to establishing new technical and operational standards for the design, construction, and operation of nuclear plants.**¶ What's needed now is a new national commitment to the development, testing, demonstration, and early stage commercialization of a broad range of new nuclear technologies -- from much smaller light-water reactors to next generation ones -- in search of a few designs that can be mass produced and deployed at a significantly lower cost than current designs. This will require both greater public support for nuclear innovation and an entirely different regulatory framework to review and approve new commercial designs.¶ In the meantime, developing countries will continue to build traditional, large nuclear power plants. **But time is of the essence.** With the lion's share of future carbon emissions coming from those emerging economic powerhouses, **the need to develop smaller and cheaper designs that can scale faster is all the more important.**¶ **A true nuclear renaissance can't happen overnight. And it won't happen so long as large and expensive light-water reactors remain our only option. But in the end, there is no credible path to mitigating climate change without a massive global expansion of nuclear energy.** If you care about climate change, nothing is more important than developing the nuclear technologies we will need to get that job done.

**Nuclear’s critical to displace coal and stop catastrophic climate change**

**Moore 4**—co-founder of Greenpeace, is chairman and chief scientist of Greenspirit Strategies Ltd. (Patrick, Going Nuclear, <http://www.washingtonpost.com/wp-dyn/content/article/2006/04/14/AR2006041401209.html>)

In the early 1970s when I helped found Greenpeace, I believed that nuclear energy was synonymous with nuclear holocaust, as did most of my compatriots. That's the conviction that inspired Greenpeace's first voyage up the spectacular rocky northwest coast to protest the testing of U.S. hydrogen bombs in Alaska's Aleutian Islands. Thirty years on, my views have changed, and the rest of **the environmental movement needs to update its views**, too, **because nuclear energy may just be the energy source that can save our planet from** another possible disaster: **catastrophic climate change**.¶ Look at it this way: More than 600 coal-fired electric plants in the United States produce 36 percent of U.S. emissions -- or nearly 10 percent of global emissions -- of CO2, the primary greenhouse gas responsible for climate change. **Nuclear energy is the only large-scale, cost-effective energy source that can reduce these emissions while continuing to satisfy** a **growing demand for power**. And these days it can do so safely.¶ I say that guardedly, of course, just days after Iranian President Mahmoud Ahmadinejad announced that his country had enriched uranium. "The nuclear technology is only for the purpose of peace and nothing else," he said. But there is widespread speculation that, even though the process is ostensibly dedicated to producing electricity, it is in fact a cover for building nuclear weapons.¶ And although I don't want to underestimate the very real dangers of nuclear technology in the hands of rogue states, we cannot simply ban every technology that is dangerous. That was the all-or-nothing mentality at the height of the Cold War, when anything nuclear seemed to spell doom for humanity and the environment. In 1979, Jane Fonda and Jack Lemmon produced a frisson of fear with their starring roles in "The China Syndrome," a fictional evocation of nuclear disaster in which a reactor meltdown threatens a city's survival. Less than two weeks after the blockbuster film opened, a reactor core meltdown at Pennsylvania's Three Mile Island nuclear power plant sent shivers of very real anguish throughout the country.¶ What nobody noticed at the time, though, was that Three Mile Island was in fact a success story: The concrete containment structure did just what it was designed to do -- prevent radiation from escaping into the environment. And although the reactor itself was crippled, there was no injury or death among nuclear workers or nearby residents. Three Mile Island was the only serious accident in the history of nuclear energy generation in the United States, but it was enough to scare us away from further developing the technology: There hasn't been a nuclear plant ordered up since then.¶ Today, there are 103 nuclear reactors quietly delivering just 20 percent of America's electricity. Eighty percent of the people living within 10 miles of these plants approve of them (that's not including the nuclear workers). Although I don't live near a nuclear plant, I am now squarely in their camp.¶ And I am not alone among seasoned environmental activists in changing my mind on this subject. British atmospheric scientist James Lovelock, father of the Gaia theory, believes that nuclear energy is the only way to avoid catastrophic climate change. Stewart Brand, founder of the "Whole Earth Catalog," says the environmental movement must embrace nuclear energy to wean ourselves from fossil fuels. On occasion, such opinions have been met with excommunication from the anti-nuclear priesthood: The late British Bishop Hugh Montefiore, founder and director of Friends of the Earth, was forced to resign from the group's board after he wrote a pro-nuclear article in a church newsletter.¶ There are signs of a new willingness to listen, though, even among the staunchest anti-nuclear campaigners. When I attended the Kyoto climate meeting in Montreal last December, I spoke to a packed house on the question of a sustainable energy future. I argued that the only way to reduce fossil fuel emissions from electrical production is through an aggressive program of renewable energy sources (hydroelectric, geothermal heat pumps, wind, etc.) plus nuclear. The Greenpeace spokesperson was first at the mike for the question period, and I expected a tongue-lashing. Instead, he began by saying he agreed with much of what I said -- not the nuclear bit, of course, but there was a clear feeling that all options must be explored.¶ Here's why: Wind and solar power have their place, but because they are intermittent and unpredictable they simply can't replace big baseload plants such as coal, nuclear and hydroelectric. Natural gas, a fossil fuel, is too expensive already, and its price is too volatile to risk building big baseload plants. Given that hydroelectric resources are built pretty much to capacity, **nuclear is,** by elimination, **the only viable substitute for coal.** It's that simple.¶ That's not to say that there aren't real problems -- as well as various myths -- associated with nuclear energy. Each concern deserves careful consideration:¶ · Nuclear energy is expensive. It is in fact one of the least expensive energy sources. In 2004, the average cost of producing nuclear energy in the United States was less than two cents per kilowatt-hour, comparable with coal and hydroelectric. Advances in technology will bring the cost down further in the future.¶ · Nuclear plants are not safe. Although Three Mile Island was a success story, the accident at Chernobyl, 20 years ago this month, was not. But Chernobyl was an accident waiting to happen. This early model of Soviet reactor had no containment vessel, was an inherently bad design and its operators literally blew it up. The multi-agency U.N. Chernobyl Forum reported last year that 56 deaths could be directly attributed to the accident, most of those from radiation or burns suffered while fighting the fire. Tragic as those deaths were, they pale in comparison to the more than 5,000 coal-mining deaths that occur worldwide every year. No one has died of a radiation-related accident in the history of the U.S. civilian nuclear reactor program. (And although hundreds of uranium mine workers did die from radiation exposure underground in the early years of that industry, that problem was long ago corrected.)¶ · Nuclear waste will be dangerous for thousands of years. Within 40 years, used fuel has less than one-thousandth of the radioactivity it had when it was removed from the reactor. And it is incorrect to call it waste, because 95 percent of the potential energy is still contained in the used fuel after the first cycle. Now that the United States has removed the ban on recycling used fuel, it will be possible to use that energy and to greatly reduce the amount of waste that needs treatment and disposal. Last month, Japan joined France, Britain and Russia in the nuclear-fuel-recycling business. The United States will not be far behind.¶ · Nuclear reactors are vulnerable to terrorist attack. The six-feet-thick reinforced concrete containment vessel protects the contents from the outside as well as the inside. And even if a jumbo jet did crash into a reactor and breach the containment, the reactor would not explode. There are many types of facilities that are far more vulnerable, including liquid natural gas plants, chemical plants and numerous political targets.¶ · Nuclear fuel can be diverted to make nuclear weapons. This is the most serious issue associated with nuclear energy and the most difficult to address, as the example of Iran shows. But just because nuclear technology can be put to evil purposes is not an argument to ban its use.¶ Over the past 20 years, one of the simplest tools -- the machete -- has been used to kill more than a million people in Africa, far more than were killed in the Hiroshima and Nagasaki nuclear bombings combined. What are car bombs made of? Diesel oil, fertilizer and cars. If we banned everything that can be used to kill people, we would never have harnessed fire.¶ The only practical approach to the issue of nuclear weapons proliferation is to put it higher on the international agenda and to use diplomacy and, where necessary, force to prevent countries or terrorists from using nuclear materials for destructive ends. And new technologies such as the reprocessing system recently introduced in Japan (in which the plutonium is never separated from the uranium) can make it much more difficult for terrorists or rogue states to use civilian materials to manufacture weapons.¶ The 600-plus coal-fired plants emit nearly **2 billion tons of CO2annually** -- **the equivalent of the exhaust from** about **300 million automobiles**. In addition, the Clean Air Council reports that coal plants are responsible for 64 percent of sulfur dioxide emissions, 26 percent of nitrous oxides and 33 percent of mercury emissions. These pollutants are eroding the health of our environment, **producing acid rain, smog, respiratory illness and mercury contamination**.¶ Meanwhile, the 103 nuclear plants operating in the United States effectively avoid the release of 700 million tons of CO2emissions annually -- the equivalent of the exhaust from more than 100 million automobiles. Imagine if the ratio of coal to nuclear were reversed so that only 20 percent of our electricity was generated from coal and 60 percent from nuclear. **This would go a long way toward cleaning the air and reducing greenhouse gas emissions.** Every responsible environmentalist should support a move in that direction.

**Coal is quite dangerous**

**Zelman 11** Joanna, The Huffington Post, "Power Plant Air Pollution Kills 13,000 People Per Year, Coal-Fired Are Most Hazardous: ALA Report", 3/15, www.huffingtonpost.com/2011/03/14/power-plant-air-pollution-coal-kills\_n\_833385.html

The American Lung Association (ALA) recently released a new report on the dramatic health hazards surrounding coal-fired power plants.¶ The report, “Toxic Air: The Case For Cleaning Up Coal-Fired Power Plants,” reveals the dangers of air pollution emitted by coal plants.¶ One of the starkest findings in the report claims, “**Particle pollution from power plants** is estimated to **kill** approximately **13,000 people a year.**”¶ So what's the biggest culprit?¶ “**Coal-fired power plants that sell electricity to the grid produce more hazardous air pollution in the U.S. than any othe**

**r industrial pollution sources**.” According to the report details, over 386,000 tons of air pollutants are emitted from over 400 plants in the U.S. per year. Interestingly, while most of the power plants are located in the Midwest and Southeast, **the entire nation is threatened by their toxic emissions**.¶ An ALA graph shows that while pollutants such as acid gases stay in the local area, metals such as lead and arsenic travel beyond state lines, and fine particulate matter has a global impact. In other words, while for some workers the pollution may be a tradeoff for employment at a plant, other regions don’t reap the same benefits, but still pay for the costs to their health.¶ The report connected specific pollutants with their health effects. According to the ALA, 76% of U.S. acid gas emissions, which are known to irritate breathing passages, come from coal-fired power plants. Out of all industrial sources, these plants are also the biggest emitter of airborne mercury, which can become part of the human food chain through fish and wildlife -- high mercury levels are linked to brain damage, birth defects, and damage to the nervous system. Overall, **air pollutants from coal plants can cause heart attacks, strokes, lung cancer, birth defects, and premature death**.¶ The American Lung Association isn’t the only group to connect coal plants with death and illness. A recent study released in the Annals of the New York Academy of Sciences found that, due in large part to health problems, coal costs the U.S. $500 billion per year. Specifically, the study found that the health costs of cancer, lung disease, and respiratory illnesses connected to pollutant emissions totaled over $185 billion per year.

**SMRs can reprocess and solve waste**

**Biello 12** David, March 27, "Small Reactors Make a Bid to Revive Nuclear Power", www.scientificamerican.com/article.cfm?id=small-reactors-bid-to-revive-nuclear-power

Alternative fuel?¶ Small modular reactors may help with two of the biggest challenges facing the nuclear industry: the growing stores of waste from existing reactors and residue from the mass production of nuclear weapons as well as the overall safety of nuclear power. GE's PRISM fast reactor, General Atomic's helium-cooled fast reactor, or Hyperion Power's liquid lead-bismuth cooled reactor **could all turn waste into fuel**. Hyperion hopes to demonstrate its reactor, capable of generating 25 megawatts of electricity, at the Savannah River National Laboratory in South Carolina. The site has also signed memorandums of understanding to host prototypes of the NuScale and Holtech reactors.

**SMRs are feasible, safer and solve other nuclear downsides**

**Ringle 10** John, Professor Emeritus of Nuclear Engineering at Oregon State University, "Reintroduction of reactors in US a major win", November 13, robertmayer.wordpress.com/2010/11/21/reintroduction-of-reactors-in-us-a-major-win/

Small nuclear reactors will probably **be the mechanism that ushers in nuclear** power’s renaissance in the U.S.¶ Nuclear plants currently supply about 20 percent of the nation’s electricity and more than 70 percent of our carbon-free energy. But large nuclear plants cost $8 billion to $10 billion and utilities are having second thoughts about how to finance these plants.¶ A small modular reactor (SMR) has several advantages over the conventional 1,000-megawatt plant:¶ 1. It ranges in size from 25 to 140 megawatts, hence only costs about a tenth as much as a large plant.¶ 2. It uses a cookie-cutter standardized design to reduce construction costs and can be built in a factory and shipped to the site by truck, railroad or barge.¶ 3. The major parts can be built in U.S. factories, unlike some parts for the larger reactors that must be fabricated overseas.¶ **4. Because of the factory-line production, the SMR could be built in three years with one-third of the workforce of a large plant**.¶ 5. More than one SMR could be clustered together to form a larger power plant complex. This provides versatility in operation, particularly in connection with large wind farms. With the variability of wind, one or more SMRs could be run or shut down to provide a constant base load supply of electricity.¶ 6. A cluster of SMRs should be very reliable. One unit could be taken out of service for maintenance or repair without affecting the operation of the other units. And since they are all of a common design, replacement parts could satisfy all units. France has already proved the reliability of standardized plants.¶ **At least half a dozen companies are developing SMRs**, including NuScale in Oregon. NuScale is American-owned and its 45-megawatt design has some unique features. **It is inherently safe**. It could be located partially or totally below ground, and with its natural convection cooling system, it does not rely on an elaborate system of pumps and valves to provide safety. **There is no scenario in which a** loss-of-coolant **accident could occur**.

### 1AC—Plan

**Plan – The United States federal government should reduce restrictions external to a fast track process for small modular reactors.**

### 1AC—Solvency

**Contention Two – Solvency**

**The plan solves the only major roadblock to the creation of a robust domestic SMR industry.**

**Loris 11** (Nicolas D. Loris – Research Associate in the Roe Institute, Jack Spencer – Research Fellow in Nuclear Energy in the Thomas A. Roe Institute for Economic Policy Studies, Currently is The Heritage Foundation’s senior reesrach fellow in nuclear energy policy, Previously worked on commercial, civilian and military components of nuclear energy at the Babcock & Wilcox Companies, Holds a bachelor's degree in international politics from Frostburg State University and a master's degree from the University of Limerick, *A Big Future for Small Nuclear Reactors?*, February 2nd, http://www.heritage.org/research/reports/2011/02/a-big-future-for-small-nuclear-reactors)

Abstract: More and more companies—in the U.S. and abroad—are investing in new commercial nuclear enterprises, chief among them, small modular reactors (SMRs). The SMR industry is growing, with many promising developments in the works—which is precisely why the government should not interfere, as subsidies and government programs have already resulted in an inefficient system for large reactors. Heritage Foundation nuclear policy experts explain how the future for small reactors can remain bright.

Small modular reactors (SMRs) have garnered significant attention in recent years, with companies of all sizes investing in these smaller, safer, and **more cost-efficient** nuclear reactors. Utilities are even forming partnerships with reactor designers to prepare for potential future construction. Perhaps most impressive is that most of this development is occurring without government involvement. Private investors and entrepreneurs are **dedicating resources** to these technologies based on their future prospects, not on government set-asides, mandates, or subsidies, and despite the current regulatory bias in favor of large light water reactors (LWRs).

The result is a young, robust, innovative, and growing SMR industry. Multiple technologies are being proposed that each have their own set of characteristics based on price, fuel, waste characteristics, size, and any number of other variables. To continue this growth, policymakers should reject the temptation to offer the same sort of subsidies and government programs that have proven ineffective for large LWRs. While Department of Energy cost-sharing programs and capital subsidies seem attractive, they have yet to net any new reactor construction. Instead, policymakers should focus on the systemic issues that have continued to thwart the expansion of nuclear power in recent years. Specifically, the federal government needs to develop an efficient and **predictable regulatory pathway** to new reactor certification and to develop a sustainable nuclear waste management strategy.

Why SMRs?

Small modular reactors share many of the attractive qualities of large reactors, such as providing abundant emissions-free power, while adding new features that could make them more appropriate for certain applications, such as providing power to rural communities or for dedicated industrial use. SMRs are not yet positioned to take the place of traditional large LWRs, but they represent an important growth area for the commercial nuclear industry.

Indeed, should the promise of small modular reactors be realized, the technology could transform the nuclear industry. That is because these attributes would potentially mitigate some of the financial and regulatory problems that nuclear energy has recently faced. SMRs potentially cost less (at least in up-front capital), are more mobile and multifunctional, provide competition, and can largely be produced by existing domestic infrastructure.

Lower Costs Up Front. Large reactors are very expensive to license and construct and require massive up-front capital investments to begin a project. Small reactors, while providing far less power than large reactors, can be built in modules and thus be paid for over time. For example, estimates for larger reactors range from $6 billion to $10 billion and must be financed all at once. The Babcock & Wilcox Company’s modular mPower reactors, alternatively, can be purchased in increments of 125 megawatts (MW), which would allow costs to be spread out over time. Though cost estimates are not yet available for the mPower reactor, its designers have stated that they will be competitive. This should not be used as a reason to refrain from building larger, 1,000-plus MW reactors. Each utility will have its own set of variables that it must consider in choosing a reactor technology, but given that one of the primary justifications for government subsidies is that the high costs of large reactors puts unacceptable strain on utility balance sheets, an option that spreads capital outlays over time should be attractive.

Safe Installation in Diverse Locations. Some designs are small enough to produce power for as few as 20,000 homes. One such reactor, Hyperion Power’s HPM (Hyperion Power Module) offers 25 MW of electricity for an advertised cost of $50 million per unit. This makes the HPM a potential power solution for isolated communities or small cities.[1] The Alaskan town of Galena, for example, is planning to power its community with a small reactor designed by Toshiba, while Fairbanks is looking into a small plant constructed by Hyperion.[2] In addition, Western Troy Capital Resources has stated that it will form a private corporation to provide electric power from small reactors for remote locations in Canada.[3] Public utility officials in Grays Harbor, Washington, have spoken with the NuScale Power company about powering the community with eight small nuclear plants;[4] and Hyperion Power has reported a high level of interest in small nuclear reactor designs from islands around the world.[5]

Using a small nuclear reactor could cut electricity costs in isolated areas since there would be no need for expensive transmission lines to carry power to remote locations.[6] SMRs could also potentially be integrated into existing energy infrastructure. SMRs could be built into old coal plants, for instance. The reactors would replace the coal boilers and be hooked into the existing turbines and distribution lines. According to the Nuclear Regulatory Commission, these modifications could be completed safely since small reactors will likely be easier to control during times of malfunction.[7]

Multi-functionality. SMRs can be used in a variety of applications that have substantial power and heat requirements. The chemical and plastics industries and oil refineries all use massive amounts of natural gas to fuel their operations. Similarly, small reactors could produce the heat needed to extract oil from tar sands, which currently requires large amounts of natural gas. While affordable today, natural gas prices vary significantly over time, so the long-term predictable pricing that nuclear provides could be very attractive. SMRs may also provide a practical solution for desalination plants (which require large amounts of electricity) that can bring fresh water to parts of the world where such supplies are depleting.[8] Perhaps most important, is that SMRs have the potential to bring power and electricity to the 1.6 billion people in the world today that have no access to electricity, and to the 2.4 billion that rely on biomass, such as wood, agricultural residue, and dung for cooking and heating.[9]

Competition. While competition among large nuclear-reactor technologies currently exists, small reactors will add a new dimension to nuclear-reactor competition. Multiple small technology designs are set to emerge on the market. Not only will competition among small reactors create a robust market, it will also provide an additional incentive for large reactors to improve. If smaller reactors begin to capture a share of the nuclear market and the energy market at large, it will drive innovation and ultimately lower prices for both new and existing technologies.

Domestic Production. Although the nuclear industry necessarily shrank to coincide with decreased demand, much of the domestic infrastructure remains in place today and could support the expansion of small-reactor technologies. Although the industrial and intellectual base has declined over the past three decades, forging production, heavy manufacturing, specialized piping, mining, fuel services, and skilled labor could all be found in the United States. Lehigh Heavy Forge Corporation in Bethlehem, Pennsylvania, could build the forges while Babcock & Wilcox could provide the heavy nuclear components, for instance. AREVA/Northrop Grumman Shipbuilding broke ground on a heavy components manufacturing facility last June.[10] Further, a number of companies are expanding manufacturing, engineering, and uranium enrichment capabilities—all in the United States.

If SMRs are so great, where is the construction?

While some designs are closer to market introduction than others, the fact is that America’s **regulatory** and policy environment is not sufficient to support a robust expansion of existing nuclear technologies, much less new ones. New reactor designs are difficult to license efficiently, and the lack of a sustainable nuclear waste management policy causes significant risk to private investment.

Many politicians are attempting to mitigate these market challenges by offering subsidies, such as loan guarantees. While this approach still enjoys broad support in Congress and industry, the reality is that it has not worked. Despite a lavish suite of subsidies offered in the Energy Policy Act of 2005, including loan guarantees, insurance against government delays, and production tax credits, no new reactors have been permitted, much less constructed. These subsidies are in addition to existing technology development cost-sharing programs that have been in place for years and defer significant research and development costs from industry to the taxpayer.

The problem with this approach is that it ignores the larger systemic problems that create the unstable marketplace to begin with. These systemic problems generally fall into three categories:

Licensing. The Nuclear Regulatory Commission (NRC) is ill prepared to build the regulatory framework for new reactor technologies, and no reactor can be offered commercially without an NRC license. In a September 2009 interview, former NRC chairman Dale E. Klein said that small nuclear reactors pose a dilemma for the NRC because the commission is uneasy with new and unproven technologies and feels more comfortable with large light water reactors, which have been in operation for years and has a long safety record.[11] The result is that enthusiasm for building non-light-water SMRs is generally squashed at the NRC as potential customers realize that there is little chance that the NRC will permit the project within a timeframe that would promote near-term investment. So, regardless of which attributes an SMR might bring to the market, the **regulatory risk** is such that real progress on commercialization is difficult to attain. This then leaves large light water reactors, and to a lesser extent, small ones, as the least risky option, which pushes potential customers toward that technology, which then undermines long-term progress, competition, and innovation.

Nuclear Waste Management. The lack of a sustainable nuclear waste management solution is perhaps the greatest obstacle to a broad expansion of U.S. nuclear power. The federal government has failed to meet its obligations under the 1982 Nuclear Waste Policy Act, as amended, to begin collecting nuclear waste for disposal in Yucca Mountain. The Obama Administration’s attempts to shutter the existing program to put waste in Yucca Mountain without having a backup plan has worsened the situation. This outcome was predictable because the current program is based on the flawed premise that the federal government is the appropriate entity to manage nuclear waste. Under the current system, waste producers are able to largely ignore waste management because the federal government is responsible. The key to a sustainable waste management policy is to directly connect financial responsibility for waste management to waste production. This will increase demand for more waste-efficient reactor technologies and drive innovation on waste-management technologies, such as reprocessing. Because SMRs consume fuel and produce waste differently than LWRs, they could contribute greatly to an economically efficient and sustainable **nuclear waste management strategy**.

Government Intervention. Too many policymakers believe that Washington is equipped to guide the nuclear industry to success. So, instead of creating a stable regulatory environment where the market value of different nuclear technologies can determine their success and evolution, they choose to create programs to help industry succeed. Two recent Senate bills from the 111th Congress, the Nuclear Energy Research Initiative Improvement Act (S. 2052) and the Nuclear Power 2021 Act (S. 2812), are cases in point. Government intervention distorts the normal market processes that, if allowed to work, would yield the most efficient, cost-effective, and appropriate nuclear technologies. Instead, the federal government picks winners and losers through programs where bureaucrats and well-connected lobbyists decide which technologies are permitted, and provides capital subsidies that allow investors to ignore the systemic problems that drive risk and costs artificially high. This approach is especially detrimental to SMRs because subsidies to LWRs distort the relative benefit of other reactor designs by artificially lowering the cost and risk of a more mature technology that already dominates the marketplace.

How to Fix a Broken System

At the Global Nuclear Renaissance Summit on July 24, 2008, then-NRC chairman Dale Klein said that a nuclear renaissance with regard to small reactors will take “decades to unfold.”[12] If Members of Congress and government agencies do not reform their current approach to nuclear energy, this will most certainly be the case. However, a new, market-based approach could lead to a different outcome. Instead of relying on the policies of the past, Congress, the Department of Energy, and the NRC should pursue a new, 21st-century model for small and alternative reactor technologies by doing the following:

Reject additional loan guarantees. Loan guarantee proponents argue that high up-front costs of new large reactors make them unaffordable without loan guarantees. Presumably, then, a smaller, less expensive modular option would be very attractive to private investors even without government intervention. But loan guarantees undermine this advantage by subsidizing the capital costs and risk associated with large reactors. A small reactor industry without loan guarantees would also provide competition and downward price pressure on large light water reactors. At a minimum, Congress should limit guarantees to no more than two plants of any reactor design and limit to two-thirds the amount of any expanded loan guarantee program that can support a single technology. Such eligibility limits will prevent support from going only to a single basic technology, such as large light water reactors.[13]

Avoid subsidies. Subsidies do not work if the objective is a diverse and economically sustainable nuclear industry. Despite continued attempts to subsidize the nuclear industry into success, the evidence demonstrates that such efforts invariably fail. The nuclear industry’s success stories are rooted in the free market. Two examples include the efficiency and low costs of today’s existing plants, and the emergence of a private uranium enrichment industry. Government intervention is the problem, as illustrated by the government’s inability to meet its nuclear waste disposal obligations.

Build expertise at the Nuclear Regulatory Commission. The NRC is built to regulate large light water reactors. It simply does not have the regulatory capability and resources to efficiently regulate other technologies, and building that expertise takes time. Helping the NRC to develop that expertise now would help bring new technologies into the marketplace more smoothly. Congress should direct and resource the NRC to develop additional broad expertise for liquid metal-cooled, fast reactors and high-temperature, gas-cooled reactors. With its existing expertise in light water technology, this additional expertise would position the NRC to effectively regulate an emerging SMR industry.

Establish a new licensing pathway. The current licensing pathway relies on reactor customers to drive the regulatory process. But absent an efficient and predictable regulatory pathway, few customers will pursue these reactor technologies. The problem is that the legal, regulatory, and policy apparatus is built to support large light water reactors, effectively discriminating against other technologies. Establishing an alternative **licensing pathway** that takes the unique attributes of small reactors into consideration could help build the necessary regulatory support on which commercialization ultimately depends.[14]

Resolve staffing, security, construction criteria, and fee-structure issues by December 31, 2011. The similarity of U.S. reactors has meant that the NRC could establish a common fee structure and many general regulatory guidelines for areas, such as staffing levels, security requirements, and construction criteria. But these regulations are inappropriate for many SMR designs that often have smaller staff requirements, unique control room specifications, diverse security requirements, and that employ off-site construction techniques. Subjecting SMRs to regulations built for large light water reactors would add cost and result in less effective regulation. The NRC has acknowledged the need for this to be resolved and has committed to doing so, including developing the budget requirements to achieve it. It has not committed to a specific timeline.[15] Congress should demand that these issues be resolved by the end of 2011.

#### Simulation and institutional deliberation are valuable and motivate effective responses to climate risks

Marx et al 7 (Sabine M, Center for Research on Environmental Decisions (CRED) @ Columbia University, Elke U. Weber, Graduate School of Business and Department of Psychology @ Columbia University, Benjamin S. Orlovea, Department of Environmental Science and Policy @ University of California Davis, Anthony Leiserowitz, Decision Research, David H. Krantz, Department of Psychology @ Columbia University, Carla Roncolia, South East Climate Consortium (SECC), Department of Biological and Agricultural Engineering @ University of Georgia and Jennifer Phillips, Bard Centre for Environmental Policy @ Bard College, “Communication and mental processes: Experiential and analytic processing of uncertain climate information”, 2007, http://climate.columbia.edu/sitefiles/file/Marx\_GEC\_2007.pdf)

Based on the observation that experiential and analytic processing systems compete and that personal experience and vivid descriptions are often favored over statistical information, we suggest the following research and policy implications.¶ Communications designed to create, recall and highlight relevant personal experience and to elicit affective responses can lead to more public attention to, processing of, and engagement with forecasts of climate variability and climate change**.** Vicarious experiential information in the **form of scenarios**, narratives, and analogies **can help** the public and **policy makers imagine the potential consequences of climate** variability and **change, amplify** or attenuate **risk perceptions, and influence** both individual behavioral intentions and **public policy preferences.** Likewise, as illustrated by the example of retranslation in the Uganda studies, **the translation of statistical information** into concrete experience **with simulated forecasts, decisionmaking and its outcomes can greatly facilitate an intuitive understanding of** both **probabilities and the** consequences of incremental change and extreme events, and **motivate contingency planning**.¶ Yet, while the engagement of experience-based, affective decision-making can make risk communications more salient and motivate behavior, experiential processing is also subject to its own biases, limitations and distortions, such as the finite pool of worry and single action bias. Experiential processing works best with easily imaginable, emotionally laden material, yet many aspects of climate variability and change are relatively abstract and require a certain level of analytical understanding (e.g., long-term trends in mean temperatures or precipitation). Ideally, communication of **climate forecasts should encourage the interactive engagement of** both analytic and experiential **processing systems in** the course of **making concrete decisions** about climate, ranging from individual choices about what crops to plant in a particular season to broad social choices about how to mitigate or adapt to global climate change.¶ One way to facilitate this interaction is through group and participatory decision-making. As the Uganda example suggests, **group processes allow individuals with a range of knowledge, skills and** personal **experience to share diverse information and perspectives and work together on a problem**. Ideally, groups should include at least one member trained to understand statistical forecast information to ensure that all sources of information—both experiential and analytic—are considered as part of the decision-making process. Communications to groups should also try to translate statistical information into formats readily understood in the language, personal and cultural experience of group members. In a somewhat iterative or cyclical process, the shared concrete information can then be re-abstracted to an analytic level that **leads to action**.¶ Risk and uncertainty are inherent dimensions of all climate forecasts and related decisions. **Analytic products like trend analysis, forecast probabilities, and ranges of uncertainty ought to be valuable contributions to stakeholder decision-making**. Yet decision makers also listen to the inner and communal voices of personal and collective experience, affect and emotion, and cultural values. Both systems—analytic and experiential—should be considered in the design of climate forecasts and risk communications. If not, many analytic products will fall on deaf ears as decision makers continue to rely heavily on personal experience and affective cues to make plans for an uncertain future. The challenge is to find innovative and creative ways to engage both systems in the process of individual and group decision-making.

**We have a moral obligation to advocate nuclear---any alternative results in extinction due to warming**

**Baker 12**—Executive Director of PopAtomic Studios, the Nuclear Literacy Project (7/25/12, Suzy, Climate Change and Nuclear Energy: We Need to Talk, ansnuclearcafe.org/2012/07/25/climate-change-and-nuclear-energy-we-need-to-talk/)

Ocean Acidification¶ While I was making artistic monuments to single celled organisms in the ceramics studio, new research was emerging about ocean acidification affecting these beautiful and integral pieces of our ecosystem. As the ocean absorbs excess carbon from humans burning fossil fuels, the pH of the ocean is rapidly changing. This means that our ancient oxygen-making pals cannot properly do their job. As their ocean home becomes inhospitable, they are dying off in droves. This not only impacts the ocean’s ability to naturally sequester man made carbon emissions; it also negatively impacts the entire food chain, since they are the primary food source for other multi-cellular ocean creatures, some of which we enjoy eating.¶ Oh, and did I mention that these little phytoplankton are also responsible for creating the ozone layer that protects **all life on the planet** from cosmic radiation, and they churn out 70-80% of the oxygen we breathe? These creatures are much more than just a pretty floating form.¶ Ocean acidification is the issue that brought me to supporting nuclear energy. Ocean acidification is an often-overlooked aspect of climate change that is potentially more threatening than the heat, the super storms, the fires, the drought, the crop losses, and all of the other trends that we are seeing now, which climate scientists have been warning us about for decades.¶ Climate Change and Nuclear Energy: Like Oil and Water?¶ It didn’t take long for me to find out that in the nuclear industry, climate change is not something we all agree on. Discussing climate change as a concern is often polarizing, and brings up intrinsic conflicts of interest in the larger energy sector (the companies who design/build/run the nuclear plants also happen to design/build/run the fossil fuel plants). I’ve been advised by people who deeply care about me, and the success of my organization, not to bring up climate at all, and to be extremely careful not to base my support of nuclear on climate issues. I’ve also been specifically advised not to make the argument that nuclear energy is the only solution to climate change.¶ When you are the new kid, it is usually best not to make waves if you can help it. So, for the most part, I have heeded that advice and held my tongue, despite myself.¶ However, as I watch the news (and my wilting vegetable garden) and see the magnitude of human suffering that is directly related to increasingly severe weather events, I cannot keep silent. Climate change is why I am here supporting nuclear energy, so what am I doing not talking about it?¶ The CEO of Exxon Mobile recently made clear that despite his company’s acknowledgement of the irrefutable evidence of climate change, and the huge ecological and human cost, he has no intentions of slowing our fossil fuel consumption. In fact, he goes as far to say that getting fossil fuels to developing nations will save millions of lives. While I agree that we need stronger, better energy infrastructure for our world’s poorest nations, I wholly disagree that fossils are the right fit for the job.¶ Fossil fuel usage could be cast as a human rights issue only to the extent that access to reliable and affordable electricity determines what one’s standard of living is. At the same time, **fossil fuel usage is the single largest threat to our planet and every species on it**. **Disregarding the impacts that fossil fuel use poses**, merely to protect and increase financial profits, **is unethical**, and cloaking fossil fuel use as a human rights issue is immoral.¶ Although we are all entitled to our own opinions and beliefs, the idea that climate change and ocean acidification are even up for debate is not reasonable. Just think: The CEO of the largest fossil fuel company in America freely speaks out about climate change, while nuclear energy advocates are pressured to stay silent on the subject.¶ **Silence is No Longer an Option**¶ I am someone who avoids conflict, who seeks consensus in my personal and professional lives, and so I have followed the advice of well-meaning mentors and stayed silent in hopes of preserving a false peace within my pro-nuclear circles, including my family and friends. But my keeping silent is now over— starting here and starting now—**because this is too big and too important to stay silent.** I am not alone in believing this, and the nuclear industry does itself no favors by tacitly excluding the growing movement of people who are passionate about the need to use nuclear energy to address climate change.¶ And nuclear power is the only realistic solution. It would be great if there were also other viable solutions that could be easily and quickly embraced; **however, the numbers just don’t work out**. Renewables and conservation may have done more good if we had utilized them on a large scale 40 years ago, when we were warned that our ecosystem was showing signs of damage from fossils fuels…but at this point it’s really too late for them. And burning more fossil fuels right now, when we have the technologies and know-how to create a carbon-free energy economy, would be the height of foolishness.¶ In the meantime, there is real human suffering, and we here in the developed world are directly causing it. Our poorest brothers and sisters cannot escape the heat. They cannot import food when their crops fail. They cannot buy bottled water when there is a drought. They cannot “engineer a solution” any more than my childhood friends the phytoplankton can.¶ ¶ Energy Choices as an Ethical Obligation¶ **We have an ethical obligation to stop killing people with our energy consumption**. That statement may sound oversimplified, but let’s be honest—we know that fossil fuels kill approximately 1.3 million people each year through respiratory diseases and cancers, and the death toll for climate change related events rises every day. Yet, we do nothing but dither about climate change politics. Where is the outrage?¶ The fossil fuel industry has been successful at presenting a united front and maintaining consistent strategic communications. In contrast, the safety record and clean energy contributions of nuclear are always overshadowed by politics favoring fossil fuel use. If anything, nuclear advocates should be particularly sensitive that the very same politics are happening with climate science.¶ We should be championing nuclear energy as a science-based solution, instead of enforcing a meek code of silence. People from outside the nuclear industry, like Gwyneth Cravens, Barry Brooks and Tom Blees, have pointed out these relationships, yet the nuclear industry has yet to internalize and accept these realities.¶ How can we expect people to listen to science and not politics when it comes to nuclear energy, but not climate change?¶ Disagreeing with a policy does not change the facts. You can disagree with policy to limit carbon emissions, but that doesn’t change the fact that our fossil fuel consumption is changing the PH of our oceans. Many people disagree with the use of nuclear energy, but that doesn’t change the fact that nuclear is our largest source of carbon free electricity and the safest source of electricity per kilowatt hour.¶ Nuclear Must Lead by Example¶ If we want the public to overcome the cognitive dissonance between science and policy when it comes to nuclear energy, **we need to lead by example** and overcome our own cognitive dissonance when it comes to climate change — even if it means risking our own interests as members of the larger energy industry. We are not going to run out of fossil fuels any time soon, so the decision to move to carbon-free energy—to move to nuclear energy—must be made willingly, and based on ethical principles, not the limits of our natural resources.¶ As green groups wait endlessly for renewable technologies to have some kind of breakthrough, and nuclear supporters stay mum on climate change, we continue using fossil fuels. Our collective inaction is allowing the destruction of our planet’s ecosystem, the dying of our oceans, and the suffering of the poorest members of our own species. The climate conversation has become so convoluted by politics and greed that many smart, compassionate people have “thrown in the towel.” We should be more concerned than ever at our lack of a comprehensive global response.¶ I strongly believe that **there’s still time to reclaim the dialogue about climate change based on ocean acidification evidence, and to use nuclear technologies to improve the long-term outcome for our planet** and our species. The first step is acknowledging the complicated and unique role of the nuclear industry in this conflict, **and the conflicts of interest that are impeding open communication.** The second step is to realize that the climate change community is a potential ally, and that openly addressing the subject of climate change in our communications is in the best interest of the nuclear community. The third step is choosing to do the right thing, not just the polite thing, and reclaim our legitimate role in the energy community as the “top dog” of carbon-free electricity, instead of quietly watching natural gas become “the new coal.”¶ Climate change is not going away—it is getting worse—and **each one of us** in the nuclear community **has an ethical obligation to speak up and to do something about it**. I am speaking up for the oceans, for the cyano-bacteria and diatoms and our shared mitochondrial RNA that still fills me with wonder at the beauty of this world. Please join me if you can, to speak up for what you love—and if you cannot, please understand that we all remain nuclear advocates, and that the nuclear community is much stronger with the no-longer-silent climate change harbingers in it.

**The state is inevitable and an indispensable part of the solution to warming**

**Eckersley 4** Robyn, Reader/Associate Professor in the Department of Political Science at the University of Melbourne, “The Green State: Rethinking Democracy and Sovereignty”, MIT Press, 2004, Google Books, pp. 3-8

While acknowledging the basis for this antipathy toward the nation- state, and the limitations of state-centric analyses of global ecological degradation, I seek to draw attention to the positive role that states have played, and might increasingly play, in global and domestic politics. Writing more than twenty years ago, Hedley Bull (a proto-constructivist and leading writer in the English school) outlined the state's positive role in world affairs, and his arguments continue to provide a powerful challenge to those who somehow seek to "get beyond the state," as if such a move would provide a more lasting solution to the threat of armed conflict or nuclear war, social and economic injustice, or environmental degradation.10 As Bull argued, **given that the state is here to stay whether we like it or not**, then the call to get "beyond the state is a counsel of despair, at all events if it means that we have to begin by abolishing or subverting the state, rather than that there is a need to build upon it.""¶ In any event, rejecting the "statist frame" of world politics ought not prohibit an inquiry into the emancipatory potential of the **state as a crucial "node" in any future network of global ecological governance**. This is especially so, given that one can expect states to persist as major sites of social and political power for at least the foreseeable future and that **any green transformations of the present political order will, short of revolution, necessarily be state-dependent**. Thus, like it or not, those concerned about **ecological destruction must contend with existing institutions** and, where possible, seek to "rebuild the ship while still at sea." And if states are so implicated in ecological destruction, then an inquiry into the potential for their transformation even their modest reform into something that is at least more conducive to ecological sustainability would seem to be compelling.¶ Of course, it would be unhelpful to become singularly fixated on the redesign of the state at the expense of other institutions of governance. States are not the only institutions that limit, condition, shape, and direct political power, and it is necessary to keep in view the broader spectrum of formal and informal institutions of governance (e.g., local, national, regional, and international) that are implicated in global environmental change. Nonetheless, while the state constitutes only one modality of political power, it is an especially significant one because of its historical claims to exclusive rule over territory and peoples—as expressed in the principle of state sovereignty. As Gianfranco Poggi explains, the political power concentrated in the state "is a momentous, pervasive, critical phenomenon. **Together with other forms of social power, it constitutes an indispensable medium for constructing and shaping larger social realities**, for establishing, shaping and maintaining all broader and more durable collectivities."12 States play, in varying degrees, significant roles in structuring life chances, in distributing wealth, privilege, information, and risks, in upholding civil and political rights, and in securing private property rights and providing the legal/regulatory framework for capitalism**. Every one of these dimensions of state activity has, for good or ill, a significant bearing on the global environmental crisis**. Given that the green political project is one that demands far-reaching changes to both economies and societies, it is difficult to imagine how such changes might occur on the kind of scale that is needed **without the active support of states**. While it is often observed that states are too big to deal with local ecological problems and too small to deal with global ones, the state nonetheless holds, as Lennart Lundqvist puts it, "a unique position in the constitutive hierarchy from individuals through villages, regions and nations all the way to global organizations. The state is inclusive of lower political and administrative levels, and exclusive in speaking for its whole territory and population in relation to the outside world."13 In short, it seems to me inconceivable to advance ecological emancipation without also engaging with and seeking to transform state power.¶ Of course, not all states are democratic states, and the green movement has long been wary of the coercive powers that all states reputedly enjoy. Coercion (and not democracy) is also central to Max Weber's classic sociological understanding of the state as "a human community that (successfully) claims the monopoly of the legitimate use of physical force within a given territory."14 Weber believed that the state could not be defined sociologically in terms of its ends\* only formally as an organization in terms of the particular means that are peculiar to it.15 Moreover his concept of legitimacy was merely concerned with whether rules were accepted by subjects as valid (for whatever reason); he did not offer a normative theory as to the circumstances when particular rules ought to be accepted or whether beliefs about the validity of rules were justified. Legitimacy was a contingent fact, and in view of his understanding of politics as a struggle for power in the context of an increasingly disenchanted world, likely to become an increasingly unstable achievement.16¶ In contrast to Weber, my approach to the state is explicitly normative and explicitly concerned with the purpose of states, and the democratic basis of their legitimacy. It focuses on the limitations of liberal normative theories of the state (and associated ideals of a just constitutional arrangement), and it proposes instead an alternative green theory that seeks to redress the deficiencies in liberal theory. Nor is my account as bleak as Weber's. The fact that states possess a monopoly of control over the means of coercion is a most serious matter, but it does not necessarily imply that they must have frequent recourse to that power. In any event, whether the use of the state's coercive powers is to be deplored or welcomed turns on the purposes for which that power is exercised, the manner in which it is exercised, and whether it is managed in public, transparent, and accountable ways—a judgment that must be made against a background of changing problems, practices, and under- standings. The coercive arm of the state can be used to "bust" political demonstrations and invade privacy. **It can also be used to prevent human rights abuses, curb the excesses of corporate power, and protect the environment.**¶ In short, although the political autonomy of states is widely believed to be in decline, **there are still few social institution that can match the** same degree of capacity and potential legitimacy that **states have to redirect societies and economies along more ecologically sustainable lines to address ecological problems** such as global warming and pollution, the buildup of toxic and nuclear wastes and the rapid erosion of the earth's biodiversity. States—particularly when they act collectively—have the capacity to curb the socially and ecologically harmful consequences of capitalism. They are also more amenable to democratization than cor- porations, notwithstanding the ascendancy of the neoliberal state in the increasingly competitive global economy. There are therefore many good reasons why green political theorists need to think not only critically but also constructively about the state and the state system. While the state is certainly not "healthy" at the present historical juncture, in this book I nonetheless join Poggi by offering "a timid two cheers for the old beast," at least as a potentially more significant ally in the green cause.17

**Scientific knowledge is best because it subjects itself to constant refinement based on empirical evidence**

**Hutcheon** **93**—former prof of sociology of education at U Regina and U British Columbia. Former research advisor to the Health Promotion Branch of the Canadian Department of Health and Welfare and as a director of the Vanier Institute of the Family. Phd in sociology, began at Yale and finished at U Queensland. (Pat, A Critique of "Biology as Ideology: The Doctrine of DNA", http://www.humanists.net/pdhutcheon/humanist%20articles/lewontn.htm)

The introductory lecture in this series articulated the increasingly popular "postmodernist" claim that all science is ideology. Lewontin then proceeded to justify this by stating the obvious: that scientists are human like the rest of us and subject to the same biases and socio-cultural imperatives. Although he did not actually say it, his comments seemed to imply that the enterprise of scientific research and knowledge building could therefore be no different and no more reliable as a guide to action than any other set of opinions. The trouble is that, **in order to reach such an conclusion, one would have to ignore all those aspects of the scientific endeavor that do** in fact **distinguish it from other** **types** and sources **of belief formation**.¶ Indeed, if the integrity of the scientific endeavor depended only on the wisdom and objectivity of the individuals engaged in it we would be in trouble. North American agriculture would today be in the state of that in Russia today. In fact it would be much worse, for the Soviets threw out Lysenko's ideology-masquerading-as-science decades ago. Precisely because an alternative scientific model was available (thanks to the disparaged Darwinian theory) the former Eastern bloc countries have been partially successful in overcoming the destructive chain of consequences which blind faith in ideology had set in motion. This is what Lewontin's old Russian dissident professor meant when he said that the truth must be spoken, even at great personal cost. How sad that Lewontin has apparently failed to understand the fact that while scientific knowledge -- with the power it gives us -- can and does allow humanity to change the world, ideological beliefs have consequences too. By rendering their proponents politically powerful but rationally and instrumentally impotent, they throw up insurmountable barriers to reasoned and value-guided social change.¶ What are the crucial differences between ideology and science that Lewonton has ignored? Both Karl Popper and Thomas Kuhn have spelled these out with great care -- the former throughout a long lifetime of scholarship devoted to that precise objective. Stephen Jay Gould has also done a sound job in this area. How strange that someone with the status of Lewontin, in a series of lectures supposedly covering the same subject, would not at least have dealt with their arguments!¶ Science has to do with the **search for regularities** in what humans experience of their physical and social environments, beginning with the most simple units discernible, and gradually moving towards the more complex. It has to do with expressing these regularities in the clearest and most precise language possible, so that cause-and-effect relations among the parts of the system under study can be **publicly and rigorously tested**. And it has to do with devising explanations of those empirical regularities which have survived all attempts to falsify them. These explanations, once phrased in the form of testable hypotheses, become **predictors of future events**. In other words, they lead to further conjectures of additional relationships which, in their turn, **must survive repeated public attempts to prove them wanting** -- if the set of related explanations (or theory) is to continue to operate as a fruitful guide for subsequent research.¶ This means that **science, unlike** mythology and **ideology, has a self-correcting mechanism at its very heart.** A conjecture, to be classed as scientific, must be amenable to empirical test. **It must, above all, be open to refutation by experience**. There is a rigorous set of rules according to which hypotheses are formulated and research findings are arrived at, reported and replicated. It is this **process** -- not the lack of prejudice of the particular scientist, or his negotiating ability, or even his political power within the relevant university department -- that ensures the reliability of scientific knowledge. The conditions established by the community of science is one of precisely defined and regulated "intersubjectivity". Under these conditions the theory that wins out, and subsequently prevails, does so not because of its agreement with conventional wisdom or because of the political power of its proponents, as is often the case with ideology. **The survival of a scientific theory** such as Darwin's **is due**, instead, **to its power to explain and predict observable regularities in human experience**, **while withstanding** worldwide **attempts to refute it** -- **and proving itself open to elaboration and expansion in the process**. **In this sense only is scientific knowledge objective and universal. All this has little relationship to the claim of an absolute universality of objective "truth" apart from human strivings** that Lewontin has **attributed to scientists**.¶ Because ideologies, on the other hand, do claim to represent truth**, they are incapable of** **generating a means by which they can be corrected** **as circumstances change.** Legitimate science makes no such claims. Scientific tests are not tests of verisimilitude. **Science does not aim for "true" theories** **purporting to reflect an accurate picture of the "essence" of reality. It leaves such claims of infallibility to ideology**. The tests of science, therefore, are in terms of workability and falsifiability, and its propositions are accordingly tentative in nature. **A successful scientific theory is** one which, while guiding the research in a particular problem area, is **continuously** elaborated, **revised and refined**, until it is eventually superseded by that very hypothesis-making and testing process that it helped to define and sharpen. An ideology, on the other hand, would be considered to have failed under those conditions, for the "truth" must be for all time. More than anything, it is this difference that confuses those ideological thinkers who are compelled to attack Darwin's theory of evolution precisely because of its success as a scientific theory. For them, and the world of desired and imagined certainty in which they live, that very success in contributing to a continuously evolving body of increasingly reliable -- albeit inevitably tentative -- knowledge can only mean failure, in that the theory itself has altered in the process.

**Advocacy for specific policy reform is key to environmental justice movements---refusal of policy relevance ensures marginalization**

Douglas S. **Noonan 5**, Assistant Professor, School of Public Policy, Georgia Institute of Technology, 2005, “DEFINING ENVIRONMENTAL JUSTICE: POLICY DESIGN LESSONS FROM THE PRACTICE OF EJ RESEARCH,” http://www.prism.gatech.edu/~dn56/EJ.APPAM.pdf

The negotiated nature of environmental policymaking holds some **stark lessons** for policymakers and analysts alike. Even if there were no uncertainty – and all of the useful scientific evidence was available – the heterogeneous interests of affected parties would persist. When policies ultimately seek to reconcile these competing interests, essentially answering questions of social choice (for which optimal solutions may not be available either in theory or due to practical limits to policy), only rarely or never would a policy process be such that selfish advocacy by interest groups yields both individually and socially optimal outcomes. In the environmental policy arena, the disconnect between the pursuit of individual interests and the pursuit of collective goals is paramount. In this sense, the acrimony surrounding many environmental policy debates is both undersandable and inevitable. ¶ Although this preface might apply equally well to discussions of “climate change policy” or “species/wilderness preservation policy,” the application to environmental justice (EJ) provides an opportune arena in which to observe the interplay between environmental policymaking and the (allegedly) relevant research. Environmental justice is a major theme in environmental and social policy. **Its researchers are legion. Their output is voluminous.** A debate about the empirical evidence and about appropriate policies continues among academics. **In** more **public forums**, **interest groups routinely cite environmental justice** in **advocating for policy reforms**. As is typical in policy debates, advocates select evidence to cite in support of their position. **The influence of scholarly EJ research on policymakers**, however, **is less than straightforward**. If the mounting evidence provides only partial answers or, as is common, **answers to questions only marginally relevant to policymakers**, then **even hundreds of books** 1 on the subject may **do little to sway public policy**. Or, conversely, the evidence’s influence may far outstrip its limited relevance. Regardless, like many other environmental policy topics, the role of scholarly research in policy design is inevitably contentious and complex. ¶ The purpose of this paper is to offer some insight about policy design from the scholarly literature on EJ. After scaling this mountain of literature, what are the important lessons to be learned for **making EJ policy?** From this vantage, this paper **critiques the field of EJ research**. It also offers some suggestions for a more policy-relevant research agenda. The conclusion returns to the broad assessment of EJ policy and suggests some future directions for designing policy and framing the discourse.

**Allowing warming to continue perpetuates racist inequalities**

**Hoerner 8—**Former director of Research at the Center for a Sustainable Economy, Director of Tax Policy at the Center for Global Change at the University of Maryland College Park, and editor of Natural Resources Tax Review. He has done research on environmental economics and policy on behalf of the governments of Canada, France, Germany, the Netherlands, Switzerland, and the United States. Andrew received his B.A. in Economics from Cornell University and a J.D. from Case Western Reserve School of Law—AND—Nia Robins—former inaugural Climate Justice Corps Fellow in 2003, director of Environmental Justice and Climate Change Initiative (J. Andrew, “A Climate of Change African Americans, Global Warming, and a Just Climate Policy for the U.S.” July 2008, http://www.ejcc.org/climateofchange.pdf)

Everywhere we turn, the issues and impacts of climate change confront us. One of the most serious environmental threats facing the world today, climate change has moved from the minds of scientists and offices of environmentalists to the mainstream. Though the media is dominated by images of polar bears, melting glaciers, flooded lands, and arid desserts, there is a human face to this story as well. Climate change is not only an issue of the environment; it is also an issue of justice and human rights, one that dangerously intersects **race and class**. All over the world people of color, Indigenous Peoples and low-income communities bear **disproportionate burdens** from climate change itself, from ill-designed policies to prevent it, and from side effects of the energy systems that cause it. A Climate of Change explores the impacts of climate change on African Americans, from health to economics to community, and considers what policies would most harm or benefit African Americans—and the nation as a whole. African Americans are thirteen percent of the U.S. population and on average emit nearly twenty percent less greenhouse gases than non-Hispanic whites per capita. Though far less responsible for climate change, African Americans are significantly more vulnerable to its effects than non- Hispanic whites. Health, housing, economic well-being, culture, and social stability are harmed from such manifestations of climate change as storms, floods, and climate variability. African Americans are also more vulnerable to higher energy bills, unemployment, recessions caused by global energy price shocks, and a greater economic burden from military operations designed to protect the flow of oil to the U.S. Climate Justice: The Time Is Now Ultimately, accomplishing climate justice will require that new alliances are forged and traditional movements are transformed. An effective policy to address the challenges of global warming cannot be crafted until race and equity are part of the discussion from the outset and an integral part of the solution. This report finds that: Global **warming amplifies nearly all existing inequalities**. Under global warming, injustices that are already unsustainable become catastrophic. Thus it is essential to recognize that all justice is climate justice and that the struggle for racial and economic justice is an unavoidable part of the fight to halt global warming. Sound global warming policy is also economic and racial justice policy. Successfully adopting a sound global warming policy will do as much to strengthen the economies of low-income communities and communities of color as any other currently plausible stride toward economic justice. Climate policies that best serve African Americans also best serve a just and strong United States. This paper shows that policies well-designed to benefit African Americans also provide the most benefit to all people in the U.S. Climate policies that best serve African Americans and other disproportionately affected communities also best serve global economic and environmental justice. Domestic reductions in global warming pollution and support for such reductions in developing nations financed by polluter-pays principles provide the greatest benefit to African Americans, the peoples of Africa, and people across the Global South. A distinctive African American voice is critical for climate justice. Currently, legislation is being drafted, proposed, and considered without any significant input from the communities most affected. Special interests are represented by powerful lobbies, while traditional environmentalists often fail to engage people of color, Indigenous Peoples, and low-income communities until after the political playing field has been defined and limited to conventional environmental goals. A strong focus on equity is essential to the success of the environmental cause, but equity issues cannot be adequately addressed by isolating the voices of communities that are disproportionately impacted. Engagement in climate change policy must be moved from the White House and the halls of Congress to social circles, classrooms, kitchens, and congregations. The time is now for those disproportionately affected to assume leadership in the climate change debate, to speak truth to power, and to assert rights to social, environmental and economic justice. Taken together, these actions affirm a vital truth that will bring communities together: Climate Justice is Common Justice. African Americans and Vulnerability In this report, it is shown that African Americans are disproportionately affected by climate change. African Americans Are at Greater Risk from Climate Change and Global Warming Co-Pollutants ¶ • The six states with the highest African American population are all in the Atlantic hurricane zone, and are expected to experience more intense storms resembling Katrina and Rita in the future. ¶ • Global warming is expected to increase the frequency and intensity of heat waves or extreme heat events. African Americans suffer heat death at one hundred fifty to two hundred percent of the rate for non-Hispanic whites. ¶ • Seventy-one percent of African Americans live in counties in violation of federal air pollution standards, as compared to fifty-eight percent of the white population. Seventy-eight percent of African Americans live within thirty miles of a coal-fired power plant, as compared to fifty-six percent of non-Hispanic whites. ¶ • Asthma has strong associations with air pollution, and African Americans have a thirty-six percent higher rate of incidents of asthma than whites. Asthma is three times as likely to lead to emergency room visits or deaths for African Americans. ¶ • This study finds that a twenty-five percent reduction in greenhouse gases—similar to what passed in California and is proposed in major federal legislation—would reduce infant mortality by at least two percent, asthma by at least sixteen percent, and mortality from particulates by at least 6,000 to 12,000 deaths per year. Other estimates have run as high as 33,000 fewer deaths per year. **A disproportionate number of the lives saved by these proposed reductions would be African American**. African Americans Are Economically More Vulnerable to Disasters and Illnesses ¶ • In 2006, twenty percent of African Americans had no health insurance, including fourteen percent of African American children—nearly twice the rate of non-Hispanic whites. ¶ • In the absence of insurance, disasters and illness (which will increase with global warming) could be cushioned by income and accumulated wealth. However, the average income of African American households is fifty-seven percent that of non-Hispanic whites, and median wealth is only one-tenth that of non-Hispanic whites. ¶ • Racist stereotypes have been shown to reduce aid donations and impede service delivery to African Americans in the wake of hurricanes, floods, fires and other climate-related disasters as compared to non-Hispanic whites in similar circumstances. African Americans Are at Greater Risk from Energy Price Shocks ¶ • African Americans spend thirty percent more of their income on energy than non-Hispanic whites. • Energy price increases have contributed to seventy to eighty percent of recent recessions. The increase in unemployment of African Americans during energy caused recessions is twice that of non-Hispanic whites, costing the community an average of one percent of income every year. • Reducing economic dependence on energy will alleviate the frequency and severity of recessions and the economic disparities they generate. African Americans Pay a Heavy Price and a Disproportionate Share of the Cost of Wars for Oil • Oil company profits in excess of the normal rate of profit for U.S. industries cost the average household $611 in 2006 alone and are still rising. • The total cost of the war in Iraq borne by African Americans will be $29,000 per household if the resulting deficit is financed by tax increases, and $32,000 if the debt is repaid by spending cuts. This is more than three times the median assets of African American households. A Clean Energy Future Creates Far More Jobs for African Americans • Fossil fuel extraction industries employ a far lower proportion of African Americans on average compared to other industries. Conversely, renewable electricity generation employs three to five times as many people as comparable electricity generation from fossil fuels, a higher proportion of whom are African American. ¶ • Switching just one percent of total electricity generating capacity per year from conventional to renewable sources would result in an additional 61,000 to 84,000 jobs for African Americans by 2030. ¶ • A well-designed comprehensive climate plan achieving emission reductions comparable to the Kyoto Protocol would create over 430,000 jobs for African Americans by 2030, reducing the African American unemployment rate by 1.8 percentage points and raising the average African American income by 3 to 4 percent.

## \*\*\* 2AC

**2AC—Solvency**

**Nuclear is competitive with natural gas.**

**Spencer 12** (Jack, Research Fellow in Nuclear Energy at The Heritage Foundation's Roe Institute for Economic Policy Studies, Current is The Heritage Foundation’s senior reesrach fellow in nuclear energy policy, Previously worked on commercial, civilian and military components of nuclear energy at the Babcock & Wilcox Companies, Holds a bachelor's degree in international politics from Frostburg State University and a master's degree from the University of Limerick, *More to the Story on Nuclear Power and Cheap Natural Gas*, http://blog.heritage.org/2012/03/16/more-to-the-story-on-nuclear-power-and-cheap-natural-gas/)

Two major financial news publications, the Economist and The Wall Street Journal, published major articles in the past week arguing that the American nuclear renaissance has ended before it ever really began. While the articles differ slightly in their presentation, the basic common thread is that new nuclear power cannot compete with cheap natural gas.

The problem with this basic narrative is twofold. First, it does not fully recognize how quickly markets change. Secondly, it ignores the potential benefits that would result from better policy.

If markets were static, then challenging such notions would be nearly impossible. Certain things are facts. Natural gas is very inexpensive. Building a nuclear plant is expensive and seemingly getting more expensive.

But that is not the end of the story.

Natural gas is cheap. No question. But it has been cheap before. Indeed, it was very cheap at about the same time the nuclear industry was last declared dead. And that’s not the only parallel. The world was responding to a recent nuclear accident at Three Mile Island (TMI), and nuclear plant construction costs were on the rise.

This caused a shift toward natural gas. As demand grew, so did its price. In 1980, natural gas cost $4.39 per 1,000 cubic feet. By 2008, it had risen to $8.43 (inflation adjusted). Producers began to seek alternatives by the early 2000s.

Back to nuclear.

As natural gas use was growing through the mid-2000s, the nuclear industry was refining its product. It continued to bring plants on line that had been permitted prior to the TMI accident and worked to hone its safety procedures and operational efficiency. The numbers show the progress. In 1979, American had 72 plants on line. Today there are 104.

Back then, America’s reactors operated at an average capacity factor of less than 60 percent. That means that the average plant spent 40 percent of that year not producing electricity. Today, reactors routinely exceed 90 percent capacity factors. This has resulted in low-cost, reliable electricity. And because the cost of fuel makes up a small percentage of actual costs, nuclear power prices do not vary over the lifetime of the plant. Best of all, these benefits are buoyed by increasing safety.

This progress positioned nuclear power to mount a comeback by the late 2000s. Indeed, 18 utilities submitted applications to the Nuclear Regulatory Commission to build nearly 30 new reactors.

Now, once again, with cost estimates rising for nuclear power, natural gas prices dropping, and renewed public anxiety fueled by a major accident, some like the Economist and The Wall Street Journal are questioning whether nuclear power has a future.

Part of the answer can be found in the Journal’s article. It points to three concerns regarding over-reliance on natural gas:

Diversity of fuel source. As one of the executives interviewed clearly states, even if one fuel source is cheap, there is great value in fuel diversity. An over-reliance on a single fuel will likely result in higher costs.

Long-term prices are unpredictable. Few expected the precipitous drop in natural gas prices that has occurred since 2008. Likewise, no one is predicting any near-term price spikes. However, if history is any guide, we should expect a rise over time. The lower prices go, the less incentive there will be to find additional reserves. The Wall Street Journal reports that this is already happening. And demand will surely increase as more natural gas is used for home heating and electricity production, and industrial applications and export opportunities emerge.

Fuel supply. There is also growing concern that existing pipeline capacity will not be adequate to support growing demand.

The rest of the answer lies with the nuclear industry and the federal government and how they interact. As the industry underwent significant safety and operational reform after TMI, the time is now for another significant reform effort geared toward relating to the federal government. These reforms should include:

**Regulatory reform**. America’s nuclear regulator, the Nuclear Regulatory Commission, does an outstanding job at regulating public health and safety for existing plants in a slow/no-growth market that is built around a single technology. It is not built to regulate a technologically diverse, growing nuclear industry.

Waste management. While the private sector efficiently manages front-end (fuel-related) activities and plant operations, the government remains in control of America’s dysfunctional regime for waste management. Under the current system, there is little connection between used-fuel management programs, economics, and the needs of the nuclear industry. Any successful plan must grow out of the private sector, be driven by sound economics, and provide access to the funds that have been set aside for nuclear waste management activities.

Though there are no guarantees, nuclear power—despite much adversity—has proved to be much more than a survivor. The right policy reforms today will open up markets to more abundant, more affordable, and even safer nuclear energy.

**This is uniquely true of SMRs.**

**Rosner 11** (Robert – Past Director of the Argonne National Laboratory, The William E. Wrather Distinguished Service Professor @ the Departments of Astronomy and Astrophysics and Physics, Enrico Fermi Institute, and the College, Senior Fellow @ the Computation Institute (CI), Stephen Goldberg – Special assistant to the director at Argonne National Laboratory, *Small Modular Reactors – Key to Future Nuclear Power Generation in the U.S.*, Energy Policy Institute at Chicago The Harris School of Public Policy Studies, Technical Paper, November 2011)

4.2 WEIGHTED AVERAGE COST OF CAPITAL AND RISK PREMIUM ANALYSIS

In both the 2004 Chicago Study and the current work, the future behavior of natural gas prices is the dominant factor when assessing the relative competitiveness of nuclear energy for base load power.12 In the absence of carbon pricing and increasingly stringent air and water quality and waste management regulation, natural gas-fired generation is cheaper than all other sources of generation at the moment. While the current outlook calls for domestic natural gas supplies to be robust and prices to remain relatively stable, natural gas markets remain **subject to volatility**. Two perturbations could occur that might cause natural gas prices to spike – pricing natural gas to its oil equivalent due to an **emerging export market** for natural gas and **shortfalls** in the realization of expected supply additions from shale gas. The study team plans to address these issues in greater detail in a future paper. Note that the natural gas market has experienced at least four price spikes in the last 10 years.13

In recent work of Dr. Rothwell (Stanford University), the uncertainty of future natural gas prices was captured in the range of estimates of the levelized cost of electricity.14 Dr. Rothwell found that there are opportunities for nuclear energy competitiveness – when decision makers require high confidence that their investments are competitive relative to other supply options. The study team further understands that this is priced into the weighted-average cost of capital (WACC). In Dr. Rothwell’s work, a variable risk premium was used for comparing GW-scale plants with natural gas-fired plants.15 The goal was to relate the risk premium to “size risk.” The conceptual basis for this approach is described further in Appendix F.

Figure 1 provides a simplified illustration of risk by comparing the size of a nuclear investment with other conventional base load investments; for comparison, the average annual revenue of investor-owned nuclear utilities is shown. This analysis, which puts significant weight on the size of the investment to measure WACC, is consistent with Moody’s Investor Service opinion that “we view nuclear generation plans as a ‘bet the farm’ endeavor for most companies, due to the size of the investment and length of time needed to build a nuclear power facility.”16

As indicated in Figure 1, on average, investor-owned U.S. utilities, representing 70% of nuclear generation, have about $13 billion in average annual revenue. A twin-unit GW-scale nuclear investment of $11 billion would represent about 90% of their annual revenues – suggesting that a larger size project presents a risk premium due to size alone that cannot be ignored and may well be substantial. However, more work needs to be done to understand the sensitivity of the risk premium in this area. For **SMR plants**, the study team has performed an initial set of calculations for a variety of WACC outcomes. The team found that the risk premium associated with project size has significant potential to be mitigated because lower upfront investments potentially shorten the pre-completion period and, therefore, lower pre-completion risk; all of these factors would result in a lower risk premium and, in turn, a lower WACC. If lower WACC is achieved, the opportunity to compete with natural gas-fired generation in both regulated and unregulated territories would be larger than for GW-scale plants, thus further enhancing the future competitiveness of SMRs. Also, Moody’s estimates that (i) financial strength metrics for both regulated and unregulated utilities (such as cash-to-debt flow ratios) and (ii) cash flow predictability for unregulated utilities are significant factors in its rating methodology (see Table 1). In the opinion of the authors, the temporal nature of cash flow predictability is an important indicator when assessing the debt quality for nuclear power plants.

**2AC—Overview**

**This is an issue of justice—minority communities bear the brunt of environmental damage with massive effects on health**

**Clark, 2008** [Catherine, MA in public Policy @ Oregon State, “Environmental Justice and Energy Production: Coal-Fired Power Plants in Illinois” http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/9770/clark-mpp.pdf?sequence=1]

Two grievances are particularly relevant today to encourage viewing energy¶ production through the **justice** perspective: the stagnation in U.S. national energy policy¶ and the negative health affects associated with coal-fired power plants. Resource¶ mobilization theory suggests that with these grievances properly framed, taken with an¶ upcoming window in national politics, it may be a propitious time to evolve the¶ movement’s agenda.

The stagnation in U.S. energy policy in reference to coal-fired power plants is¶ related to the Clean Air Act and its enforcement. The Environmental Protection Agency¶ (2008a) describes how the act was originally passed by Congress in 1970. The Clean Air¶ Act applied to, among other sources of air pollution, coal-fired power plants built after¶ 1970. It also included a “grandfather clause” that exempted existing coal-fired power¶ plants from being regulated under the act. The goal of Congress was to allow plants with¶ cleaner technology to replace old plants thereby cleaning up the air without an undo¶ burden on the energy industry or customers having to pay suddenly higher energy price

As new plants opened to replace old plants, more and more plants would be regulated by¶ and subject to the restrictions of the Clean Air Act (Hawkins, 2000).¶ However, a large number of the coal-fired power plants built before 1970 are still¶ in operation. Instead of not being regulated at all, they are regulated under the Clean Air¶ Act’s New Source Review program (NSR) (Rogers, 1990). When a grandfathered plant¶ is "modified," it becomes subject to the Clean Air Act. “Modification” is defined broadly¶ to include “any physical change or change in method of operation” that increases¶ emissions. The EPA rules, however, provide an exclusion for “routine maintenance,¶ repair, and replacement” (Hawkins, 2000). It is this exclusion that has allowed many old¶ coal-fired power plants to stay in operation emitting higher levels of pollution. It has¶ become the strategy of the power industry to use capital investments to upgrade existing¶ plants to run longer rather than having them retire and be replaced by newer more¶ efficient and cleaner plants (Hawkins, 2000). This problem may have been exacerbated¶ by the mid 1990’s push for electricity deregulation. Long (1997) and Coequyt and¶ Stanfield (1999) indicate that with individuals able to choose their own energy supplier,¶ many are choosing the least expensive. This moves an even greater demand for¶ electricity back to the oldest and dirtiest coal-fired power plants that are able to deliver a¶ cheap product at the expense of environmental concerns.¶ The second grievance is the possible negative health effects of living near a coalfired¶ power plant. Keating and Davis (2002) and Keating (2004) have studied the¶ connection between coal-fired power plants and African American and Latino¶ communities. They describe the most troublesome pollutants as ozone, sulfur dioxides,¶ particulate matter, nitrogen oxides, mercury, and carbon dioxide. Particulate matter¶ comes in two forms: particulate matter 10 micrometers or less in diameter (PM10) and¶ particulate matter 2.5 micrometers or less in diameter (PM2.5, also known as fine¶ particulate matter). Mercury has only recently been limited and only for those plants¶ subject to the full Clean Air Act, and carbon dioxide is not currently regulated (EPA,¶ 2008b). The other pollutants listed above have been regulated as part of the Clean Air¶ Act for the past few decades. Keating and Davis (2002) describe that asthma///

 attacks send¶ African Americans to the emergency room at three times the rate (174.3 visits per 10,000¶ persons) of whites (59.4 visits per 10,000 persons). African Americans are hospitalized¶ for asthma at more than three times the rate of whites (35.6 admissions per 10,000¶ population vs. 10.6 admissions per 10,000 population). More than fifty percent of¶ Latinos live in areas that violate the federal air pollution standards for ozone (Keating,¶ 2004). The health effects from dirty air may be exacerbated in poor and minority¶ communities where health coverage rates are low (Keating and Davis, 2002, Keating,¶ 2004).

Given these grievances, the resources currently available to the environmental¶ justice movement and its new agenda of global climate change, PERRO may be leading¶ the way for the movement to begin addressing **energy production** from a **justice**¶ **perspective**. This paper examines the claim of disproportionate siting of coal-fired power¶ plants in poor and minority communities in the state of Illinois by employing geographic¶ and regression analysis techniques.

**2AC—Fear**

**Our framing of warming overcomes disbelief and mobilizes public responses.**

**Romm 12** (Joe Romm is a Fellow at American Progress and is the editor of Climate Progress, which New York Times columnist Tom Friedman called "the indispensable blog" and Time magazine named one of the 25 “Best Blogs of 2010.″ In 2009, Rolling Stone put Romm #88 on its list of 100 “people who are reinventing America.” Time named him a “Hero of the Environment″ and “The Web’s most influential climate-change blogger.” Romm was acting assistant secretary of energy for energy efficiency and renewable energy in 1997, where he oversaw $1 billion in R&D, demonstration, and deployment of low-carbon technology. He is a Senior Fellow at American Progress and holds a Ph.D. in physics from MIT., 2/26/2012, “Apocalypse Not: The Oscars, The Media And The Myth of ‘Constant Repetition of Doomsday Messages’ on Climate”, http://thinkprogress.org/romm/2012/02/26/432546/apocalypse-not-oscars-media-myth-of-repetition-of-doomsday-messages-on-climate/#more-432546)

The two greatest myths about global warming communications are 1) constant repetition of doomsday messages has been a major, ongoing strategy and 2) that strategy doesn’t work and indeed is actually counterproductive! These myths are so deeply ingrained in the environmental and progressive political community that when we finally had a serious shot at a climate bill, the powers that be decided not to focus on the threat posed by climate change in any serious fashion in their $200 million communications effort (see my 6/10 post “Can you solve global warming without talking about global warming?“). These myths are so deeply ingrained in the mainstream media that such messaging, when it is tried, is routinely attacked and denounced — and the **flimsiest studies** are interpreted exactly backwards to drive the **erroneous message** home (see “Dire straits: Media blows the story of UC Berkeley study on climate messaging“) The only time anything approximating this kind of messaging — not “doomsday” but what I’d call blunt, science-based messaging that also makes clear the problem is solvable — was in 2006 and 2007 with the release of An Inconvenient Truth (and the 4 assessment reports of the Intergovernmental Panel on Climate Change and media coverage like the April 2006 cover of Time). The **data suggest** that strategy **measurably moved** the public to become more concerned about the threat posed by global warming (see recent study here). You’d think it would be pretty obvious that the public is not going to be concerned about an issue unless one explains why they should be concerned about an issue. And the **social science literature**, including the vast literature on advertising and marketing, could not be clearer that **only repeated messages** have any chance of sinking in and moving the needle. Because I doubt any serious movement of public opinion or mobilization of political action could possibly occur until these **myths are shattered**, I’ll do a multipart series on this subject, featuring public opinion analysis, quotes by leading experts, and the latest social science research. Since this is Oscar night, though, it seems appropriate to start by looking at what messages the public are exposed to in popular culture and the media. It ain’t doomsday. Quite the reverse, climate change has been mostly an **invisible** issue for several years and the message of conspicuous consumption and business-as-usual reigns supreme. The motivation for this post actually came up because I received an e-mail from a journalist commenting that the “constant repetition of doomsday messages” doesn’t work as a messaging strategy. I had to demur, for the reasons noted above. But it did get me thinking about what messages the public are exposed to, especially as I’ve been rushing to see the movies nominated for Best Picture this year. I am a huge movie buff, but as parents of 5-year-olds know, it isn’t easy to stay up with the latest movies. That said, good luck finding a popular movie in recent years that even touches on climate change, let alone one a popular one that would pass for doomsday messaging. Best Picture nominee The Tree of Life has been billed as an environmental movie — and even shown at environmental film festivals — but while it is certainly depressing, climate-related it ain’t. In fact, if that is truly someone’s idea of environmental movie, count me out. The closest to a genuine popular climate movie was the dreadfully unscientific The Day After Tomorrow, which is from 2004 (and arguably set back the messaging effort by putting the absurd “global cooling” notion in people’s heads! Even Avatar, the most successful movie of all time and “the most epic piece of environmental advocacy ever captured on celluloid,” as one producer put it, omits the climate doomsday message. One of my favorite eco-movies, “Wall-E, is an eco-dystopian gem and an anti-consumption movie,” but it isn’t a climate movie. I will be interested to see The Hunger Games, but I’ve read all 3 of the bestselling post-apocalyptic young adult novels — hey, that’s my job! — and they don’t qualify as climate change doomsday messaging (more on that later). So, no, the movies certainly don’t expose the public to constant doomsday messages on climate. Here are the key points about what repeated messages the American public is exposed to: The broad American public is exposed to virtually **no doomsday messages**, let alone constant ones, on climate change in popular culture (TV and the movies and even online). There is not one single TV show on any network devoted to this subject, which is, arguably, more consequential than any other preventable issue we face. The same goes for the news media, whose coverage of climate change has collapsed (see “Network News Coverage of Climate Change Collapsed in 2011“). When the media do cover climate change in recent years, the overwhelming majority of coverage is devoid of any doomsday messages — and many outlets still feature hard-core deniers. Just imagine what the public’s view of climate would be if it got the same coverage as, say, unemployment, the housing crisis or even the deficit? When was the last time you saw an “employment denier” quoted on TV or in a newspaper? The public is exposed to constant messages promoting business as usual and indeed idolizing conspicuous consumption. See, for instance, “Breaking: The earth is breaking … but how about that Royal Wedding? Our political elite and intelligentsia, including MSM pundits and the supposedly “liberal media” like, say, MSNBC, **hardly even talk about** climate change and when they do, it isn’t doomsday. Indeed, there isn’t even a single national columnist for a major media outlet who writes primarily on climate. Most “liberal” columnists rarely mention it. At least a quarter of the public chooses media that devote a vast amount of time to the notion that global warming is a hoax and that environmentalists are extremists and that clean energy is a joke. In the MSM, conservative pundits routinely trash climate science and mock clean energy. Just listen to, say, Joe Scarborough on MSNBC’s Morning Joe mock clean energy sometime. The major energy companies bombard the airwaves with millions and millions of dollars of repetitious pro-fossil-fuel ads. The environmentalists spend far, far less money. As noted above, the one time they did run a major campaign to push a climate bill, they and their political allies including the president explicitly did NOT talk much about climate change, particularly doomsday messaging Environmentalists when they do appear in popular culture, especially TV, are routinely mocked. There is very little mass communication of doomsday messages online. Check out the most popular websites. General silence on the subject, and again, what coverage there is ain’t doomsday messaging. Go to the front page of the (moderately trafficked) environmental websites. Where is the doomsday? If you want to find anything approximating even modest, blunt, science-based messaging built around the scientific literature, interviews with actual climate scientists and a clear statement that we can solve this problem — well, you’ve all found it, of course, but the only people who see it are those who go looking for it. Of course, this blog is not even aimed at the general public. Probably 99% of Americans haven’t even seen one of my headlines and 99.7% haven’t read one of my climate science posts. And Climate Progress is probably the most widely read, quoted, and reposted climate science blog in the world. Anyone dropping into America from another country or another planet who started following popular culture and the news the way the overwhelming majority of Americans do would get the distinct impression that **nobody who matters** is terribly worried about climate change. And, of course, they’d be right — see “The failed presidency of Barack Obama, Part 2.” It is **total BS** that somehow the American public has been scared and overwhelmed by repeated doomsday messaging into some sort of climate fatigue. If the public’s concern has dropped — and public opinion analysis suggests it has dropped several percent (though is bouncing back a tad) — that is primarily due to the conservative media’s **disinformation campaign** impact on Tea Party conservatives and to the treatment of this as a **nonissue** by most of the rest of the media, intelligentsia and popular culture.

**The 1AC is a *challenge* message not a threat message. That increases salience, collective action, and creative problem-solving.**

Robert **BRULLE** Sociology & Envt’l Science @ Drexel **’10** “From Environmental Campaigns to Advancing the Public Dialog: Environmental Communication for Civic Engagement” *Environmental Communication* 4 (1) p. 92

From Identity to Challenge Campaigns One of the most common assumptions in designing identity-based environmental communication campaigns is that fear appeals are counterproductive. As Swim et al. (2009, p. 80) note: ‘‘well meaning attempts to create urgency about climate change by appealing to fear of disasters or health risks frequently lead to the exact opposite of the desired response: denial, paralysis, apathy, or actions that can create greater risks than the one being mitigated.’’ While the author goes on to qualify and expand this line of argument, this has been taken as an absolute in the popular press and much of the grey literature produced by nonprofit organizations and foundations. However, the academic literature portrays a much more complex picture: whereas apocalyptic rhetoric has been shown to be able to evoke powerful feelings of **issue salience** (O’Neill & Nicholson-Cole, 2009, p. 373), reassuring messages, such as those advocated by ecoAmerica, have the least ability to increase issue salience (de Hoog, Stroebe, & de Wit, 2007; Lowe et al., 2006; Meijinders, Cees, Midden, & Wilke, 2001; Witte & Allen, 2000). Additionally, apocalyptic messages do not necessarily result in denial. A number of empirical studies show that individuals respond to threat appeals with an **increased focus** on **collective action** (Eagly & Kulesa, 1997; Langford, 2002; Leiserowitz, Kates, & Parris, 2006, p. 437; Maiteny, 2002; Shaiko, 1999; Swim et al., 2009, p. 94). Tomaka, Blascovich, Kelsey, and Leitten (1993, p. 248) distinguish between threat and **challenge messaging**: threat messages ‘‘are those in which the perception of danger exceeds the perception of abilities or resources to cope with the stressor. **Challenge appraisals**, in contrast, are those in which the perception of danger does not exceed the perception of resources or abilities to cope.’’ If a meaningful response to a threat can be taken that is within the resources of the individual, this results in a challenge, which ‘‘may galvanize creative ideas and actions in ways that transform and **strengthen** the **resilience** and **creativity** of individuals and communities’’ (Fritze, Blashki, Burke, & Wieseman, 2008, p. 12). While fear appeals can lead to maladaptive behaviors, fear combined with information about effective actions can also be strongly motivating (O’Neill & Nicholson-Cole, 2009, p. 376; Witte & Allen, 2000).

**2AC—SO2**

**Current warming proves CO2 overwhelms SO2.**

**No uniqueness --- aerosols decreasing.**

**Kuylenstierna 12** (Johan C.I., Director of the Stockholm Environment Institute at York, based in the University of York. His research concentrates on regional assessments of air pollution risks to ecosystems and on links between scientific information and policy making, Global Environment Outlook 5: Environment for the Future We Want,” United Nations Environment Programme, Chapter 2: Atmosphere)

Since issues of transboundary air pollution were highlighted in Agenda 21 (UNCED 1992) there have been **considerable reductions** in sulphur dioxide emissions in Europe and North America, achieving the targets of the CLRTAP protocols, the National Emission Ceiling (NEC) Directives of the European Union (EU) and clean air legislation in Canada and the United States (Figure 2.8). Key to the development of country targets in Europe was the use of critical loads (deposition thresholds above which harmful effects are observed) (Nilsson and Grennfelt 1988). Successful implementation of legislation brought about a drop of around 20 per cent in global emissions between 1980 and 2000. Emissions from Europe and North America were dominant until about 2000, when East Asian emissions started to dominate. According to the Representative Concentration Pathway (RCP) scenarios (Figure 2.8), global sulphur dioxide emissions were projected to decline steadily after 2005, and by 2050 to be 30, 50 or 70 per cent lower than 2000 levels. This set of four new pathways was developed for the climate modelling community as a basis for near- and long-term modelling experiments (van Vuuren et al. 2011; Moss et al. 2010).

As sulphur deposition has abated in Europe and North America, acidification has also diminished and some freshwater ecosystems have recovered, although critical loads are still exceeded in some areas (Wright et al. 2005; Stoddard et al. 1999). In Asia, the increase in emissions has put sensitive ecosystems at risk from the effects of soil acidification (Figure 2.9). However, the large-scale acidification of natural lakes experienced in Europe and North America has not been seen in Asia, and may be unlikely due to the nature of the region’s soil and geology (Hicks et al. 2008). In 2005 it was estimated that the critical load for soils in China was exceeded by sulphur deposition across 28 per cent of the country’s territory, mainly in eastern and south-central China. The area in exceedance is projected to decrease to 20 per cent in 2020, given the implementation of current plans for emission reductions (Zhao et al. 2009).

Further action on sulphur emissions is being taken through the revision of the **Gothenburg Protocol** in Europe. In Asia, action is also being taken to improve the efficiency of energy use and reduce sulphur dioxide emissions. For example, as part of its five-year plans, **China implemented** flue-gas desulphurization and the phasing out of small, inefficient units in the power sector in a move to achieve the national goal of a 10 per cent reduction in sulphur dioxide emissions between 2005 and 2010 (Zhang 2010).

**Global efforts** are also being made to reduce sulphur emissions from key sectors, including **transport** and **shipping**. The human health effects of particulate matter measuring 2.5 micrometres or less in diameter (PM2.5) are being tackled by lowering the sulphur content of diesel fuels – for example, UNEP’s Partnership for Clean Fuels and Vehicles (PCFV) is promoting the reduction of sulphur in vehicle fuels to 50ppm or below worldwide (UNEP 2012). Sulphur emissions from shipping have become an important policy issue in Europe, while the International Convention for the Prevention of Marine Pollution from Ships (MARPOL) is committed to the progressive global reduction in emissions of sulphur oxides, nitrogen oxides and particulate matter (MARPOL 2011 Annex VI).

**SO2 increases warming.**

**WCR 5** (World Climate Report, Change of Direction: Do SO2 Emissions Lead to Warming?, April 22th , http://www.worldclimatereport.com/index.php/2005/04/22/change-of-direction-do-so2-emissions-lead-to-warming/)

Many scientists believe that sulfur dioxide emissions, either from un-scrubbed power plants or from large-scale agricultural burning, serve to cool the planet’s surface temperature. The cooling mechanism is fairly straightforward. Sulfur dioxide is transformed in the atmosphere into sulfate aerosol, a fine particle that reflects away the sun’s radiation. The particles also serve as the condensation nuclei for cloud droplets which also reflect away the sun’s energy. On the other hand, no one really knows the magnitude of these cooling effects (if any). So we have argued that sulfate cooling is simply a **fudge factor** put into climate models in order to chill the overly-hot projections they make if left to their own devices. Now comes evidence that sulfur dioxide actually can enhance global warming. While this doesn’t mean that sulfates aren’t also cooling things by reflecting away radiation, the parent, sulfur dioxide, can do some other things that **make the surface warmer**. According to research just published in Geophysical Research Letters by J. Notholt and his co-authors, sulfur dioxide is converted to sulfuric acid (remember “acid rain”?), which leads to **more ice crystals** in the upper atmosphere. Some of these are eventually lifted upwards into the stable **stratosphere** where they increase the amount of water vapor found there. Water vapor in the stratosphere serves as a greenhouse gas and is involved in the destruction of ozone, resulting in a stratospheric cooling and a warming of the lower atmosphere and surface. And, for once, it’s not from the USA. We’re usually blamed for the lion’s share of warming as a result of our carbon dioxide emissions. But the sulfur dioxide is largely from elsewhere. The authors write: While anthropogenic SO2 emissions in Europe and North America have been decreasing since around 1980, the anthropogenic SO2 emissions from China, Asia and the tropics have been increasing…For example, van Aardenne et al (2001) report a factor of 12 increase for China and 8 for East Asia, respectively between 1950 and 1990. The authors propose that their mechanism has been responsible for about **one-quarter** of the increases in stratospheric water vapor during the period 1950 to 2000. According to a NASA model published by Drew Shindell in 2001, this would account for about 5% of the observed warming. While that seems small, it is a sign about how little we really know (or have known) about the climatic disposition of sulfur dioxide. Every increment of warming that it causes takes away from its putative cooling. Which means, ironically, that it can serve less and less as an explanation as to why we have only witnessed a very modest global warming to date.

**2AC—Proper**

**Studies prove the link between CO2 and climate change.**

**Van Renssen 12** (Sonja, How carbon dioxide melted the world, <http://www.nature.com.proxy.library.emory.edu/news/how-carbon-dioxide-melted-the-world-1.10393>)

Rising levels of carbon dioxide really did bring about the end of the most recent ice age, say researchers. By compiling a global climate record, a team has shown that regions in which concentrations of greenhouse gases increased after the warming were exceptions to the big picture.

There are many ideas about what caused the end of the last ice age 10,000 years ago, but a lack of data has hindered testing of hypotheses. It has been known that changes in temperature and CO2 levels were closely correlated during this time, but no one has been able to prove that CO2 caused the warming.

A lack of data has hindered the testing ideas about the end of the last ice age.

Ice samples from Antarctica even suggested that temperatures rose a few centuries before CO2 levels, making it impossible for the gas to have been responsible. This provided ammunition for climate sceptics.

But, by analysing data gathered from 80 locations around the world, Jeremy Shakun, a palaeo-climatologist at Harvard University in Cambridge, Massachusetts, and his colleagues have shown that at the global level, warming followed CO2 increases. The team used seven different records of past temperature, including ice cores, ancient pollen and the chemical composition of fossilized microscopic life.

“This is the first effort to get most of the data that’s out there together,” says Shakun. “It's the first hard empirical proof that CO2 was a big driver of global warming out of the ice age.” The finding is published in Nature today1.

Atmospheric CO2 levels increased by around 100 parts per million over the course of several thousand years at the end of the last ice age. Concentrations rose by the same amount in the twentieth century, and are projected to increase by even more in the twenty-first.

Drivers of deglaciation

The global record shows that the end of the ice age was probably triggered by changes in Earth’s orbit and subsequent shifts in the ocean currents that move heat around the world. But rising CO2 levels amplified this initially regional warming.

It's not clear what caused the rise in carbon dioxide. One idea is that it leached out of the deep ocean when melting ice and shifting winds brought water rich in the gas up to the surface.

In Antarctica, the temperature rose more quickly than elsewhere owing to a slowing of the ocean currents that usually carry heat away from the south to the north. This accounts for the lag between the carbon dioxide and temperature records on that continent.

“This article confirms once more the role of CO2 in climate change," says Jean-Pascal van Ypersele, a climatologist at the French-speaking Catholic University of Louvain in Belgium. "It very nicely solves one of the apparent discrepancies between the Antarctic temperature record and the evolution of CO2 concentration.”

Shakun's team backed up its interpretation of the real-world data with climate-modelling simulations. They examined several drivers of past warming, including dust, loss of ice sheets — which causes warming because ice reflects sunlight, so when it retreats, more sunlight reaches Earth — other greenhouse gases such as methane and nitrous oxide, and changes in vegetation coverage. The team found that **CO2 levels were more important** than any of these factors in driving warming.

**The plan accesses a huge export market.**

**Rosner 11** (Robert, Stephen Goldberg, Energy Policy Institute at Chicago, The Harris School of Public Policy Studies, November 2011, SMALL MODULAR REACTORS –KEY TO FUTURE NUCLEAR POWER GENERATION IN THE U.S., <https://epic.sites.uchicago.edu/sites/epic.uchicago.edu/files/uploads/EPICSMRWhitePaperFinalcopy.pdf>)

Previous studies have documented the potential for a significant export market for U.S. SMRs, mainly in lesser developed countries that do not have the demand or infrastructure to accommodate GW-scale LWRs. Clearly, the economics of SMR deployment depends not only on the cost of SMR modules, but also on the substantial upgrades in all facets of infrastructure requirements, particularly in the safety and security areas, that would have to be made, and as exemplified by the ongoing efforts in this direction by the United Arab Emirates (and, in particular, by Abu Dhabi). This is a substantial undertaking for these less developed countries. Thus, such applications may be an attractive market opportunity for FOAK SMR plants, even if the cost of such plants may not have yet achieved all of the learning benefits.

The Department of Commerce has launched the Civil Nuclear Trade Initiative, which seeks to identify the key trade policy challenges and the most significant commercial opportunities. The Initiative encompasses all aspects of the U.S. nuclear industry, and, as part of this effort, the Department identified 27 countries as “markets of interest” for new nuclear expansion. A recent Commerce Department report identified that “SMRs can be a solution for certain markets that have smaller and less robust electricity grids and limited investment capacity.” Studies performed by Argonne National Laboratory suggest that SMRs would appear to be a feasible power option for countries that have grid capacity of 2,000-3,000 MW. Exports of SMR technology also could play an important role in furthering non-proliferation policy objectives. The design of SMR nuclear fuel management systems, such as encapsulation of the fuel, may have non-proliferation benefits that merit further assessment. Also, the development of an SMR export industry would be step toward a U.S.-centric, bundled reliable fuel services.

**2AC—Framework**

**Anti-nuclear opposition is responsible for the spread of coal. Their framework simply re-affirms the structural forces that make anti-blackness possible in the form of coal pollution.**

**King 9** - Host and Executive Producer of “White House Chronicle” — a news and public affairs program airing on PBS After 40 Years, Environmentalists Start To See the Nuclear Light, Llewellyn King, November 25, 2009 – 8:47 pm

Although very little happened, Nov. 24 was a red letter day for the nation’s nuclear power industry. No new nuclear reactors were purchased, no breakthrough in treating nuclear waste was announced, and the Obama administration did not declare that it would pay for new reactors.¶ Instead, the source of the industry’s happiness was The Washington Post leading Page One with an article that detailed how the environmental movement, after 40 years of bitter opposition, now concedes that nuclear power will play a role in averting further harm from global warming.¶ Mind you, not every environmental group has come around, but the feared and respected Natural Resources Defense Council has allowed that there is a place for nuclear power in the world’s generating mix and Stephen Tindale, a former anti-nuclear activist with Friends of the Earth in the United Kingdom, has said, yes, we need nuclear.¶ For the nuclear industry which has felt itself vilified, constrained and damaged by the ceaseless and sometimes pathological opposition of the environmental movement, this changing attitude is manna from on high.¶ No matter that the environmentalists, in opposing nuclear since the late 1960s, have critically wounded the U.S. reactor industry and **contributed to the construction of scores of coal** and gas-fired **plants** that **would not have been built** **without their opposition to nuclear**.¶ In short, the environmental movement contributed in no small way to driving electric utilities to the carbon fuels they now are seeking to curtail.¶ Nuclear was such a target of the environmental movement that it embraced the “anything but nuclear” policy with abandon. Ergo its enthusiasm for all forms of alternative energy and its spreading of the belief —still popular in left-wing circles — that wind and solar power, with a strong dose of conservation, is all that is needed.¶ A third generation of environmental activists, who have been preoccupied with global climate change, have come to understand that a substantial amount of new electric generation is needed. Also some environmentalists are beginning to be concerned about the visual impact of wind turbines, not to mention their lethality to bats and birds.¶ Of all of the deleterious impacts of modern life on the Earth, it is reasonable to ask why the environmentalists went after nuclear power. And why they were opposed to nuclear power even before the 1979 accident at Three Mile Island in Pennsylvania and the catastrophic 1986 Chernobyl reactor failure in Ukraine. Those deserved pause, but the movement had already indicted the entire nuclear enterprise.¶ Having written about nuclear energy since 1969, I have come to believe that the environmental movement seized on nuclear first because it was an available target for legitimate anger that had spawned the movement in the ’60s. The licensing of nuclear power plants gave the protesters of the time one of the only opportunities to affect public policy in energy. They seized it; at first timorously, and then with gusto.¶ The escalation in environmental targets tells the story of how the movement grew in confidence and expertise; and how it added political allies, like Ralph Nader and Rep. Ed Markey, D-Mass.¶ The first target was simply the plants’ cooling water heating up rivers and estuaries. That was followed by wild extrapolations of the consequences of radiation (mutated children). Finally, it settled on the disposition of nuclear waste; that one stuck, and was a lever that turned public opinion easily. Just mention the 240,000-year half-life of plutonium without mentioning how, as an alpha-emitter, it is easily contained.¶ It is not that we do not need an environmental movement. We do. It is just that sometimes it gets things wrong.¶ In the days of the Atomic Energy Commission, the environmental groups complained that it was policeman, judge and jury. Indeed.¶ But environmental groups are guilty of **defining environmental virtue and then policing it**, **even when the result is a grave distortion**, **as in the nuclear imbroglio**. Being both the **arbiter of environmental purity** **and the enforcer** has **cost the environment 40 years** when it comes to reducing greenhouse gases.

 **Finally, energy policy advocacy is a tool not a trap --- we should build momentum and support for energy changes.**

**Shove & Walker 7** Elizabeth Sociology @ Lancaster Gordon Geography @ Lancaster “CAUTION! Transitions ahead: politics, practice, and sustainable transition management” *Environment and Planning C* 39 (4)

For academic readers, our commentary argues for loosening the intellectual grip of ‘innovation studies’, for backing off from the nested, hierarchical multi-level model as the only model in town, and for exploring other social scientific, but also systemic theories of change. The more we think about the politics and practicalities of reflexive transition management, the more complex the process appears: for a policy audience, our words of caution could be read as an invitation to abandon the whole endeavour. If agency, predictability and legitimacy are as limited as we’ve suggested, this might be the only sensible conclusion.However, we are with Rip (2006) in recognising the value, productivity and everyday necessity of an ‘**illusion of agency’**, and of the working expectation that a difference can be made even in the face of so much evidence to the contrary. The outcomes of actions are unknowable, the system unsteerable and the effects of deliberate intervention inherently unpredictable and, ironically, it is this that sustains concepts of agency and management. As Rip argues ‘**illusions are productive** because they **motivate action** and repair work, and thus something (whatever) is achieved’ (Rip 2006: 94). Situated inside the systems they seek to influence, governance actors – and actors of other kinds as well - are part of the **dynamics of change**: even if they cannot steer from the outside they are **necessary to processes within**. This is, of course, also true of academic life. Here we are, busy critiquing and analysing transition management in the expectation that somebody somewhere is listening and maybe even taking notice. If we removed that illusion would we bother writing anything at all? Maybe we need such fictions to keep us going, and maybe – fiction or no - somewhere along the line something really does happen, but not in ways that we can anticipate or know.

**2AC—State Good**

**State focused nuclear power solutions key**

**Nordhaus 11**, chairman – Breakthrough Instiute, and Shellenberger, president – Breakthrough Insitute, MA cultural anthropology – University of California, Santa Cruz, 2/25/‘11

(Ted and Michael, <http://thebreakthrough.org/archive/the_long_death_of_environmenta>)

Tenth, we are going to have to get over our suspicion of technology, **especially nuclear power.** There is **no credible path** to reducing global carbon emissions without an enormous expansion of nuclear power. It is the only low carbon technology we have today with the demonstrated capability to generate large quantities of centrally generated electrtic power. It is the low carbon of technology of choice for much of the rest of the world. Even uber-green nations, like Germany and Sweden, have reversed plans to phase out nuclear power as they have begun to reconcile their energy needs with their climate commitments. Eleventh, **we will need to embrace** again **the role of the state** as a direct provider of public goods. The modern environmental movement, borne of the new left rejection of social authority of all sorts, has embraced the notion of state regulation and even creation of private markets while largely rejecting the generative role of the state. In the modern environmental imagination, government promotion of technology - whether nuclear power, the green revolution, synfuels, or ethanol - almost always ends badly. Never mind that virtually the **entire history** of American industrialization and technological innovation is the story of government investments in the development and commercialization of new technologies. Think of a transformative technology over the last century - computers, the Internet, pharmaceutical drugs, jet turbines, cellular telephones, nuclear power - and what you will find is government investing in those technologies at a scale that private firms simply cannot replicate. Twelveth, big is beautiful. The rising economies of the developing world will continue to develop **whether we want them to or not.** The solution to the ecological crises wrought by modernity, technology, and progress will be more modernity, technology, and progress. The solutions to the ecological challenges faced by a planet of 6 billion going on 9 billion **will not be decentralized energy** technologies like solar panels, small scale organic agriculture, and a drawing of unenforceable boundaries around what remains of our ecological inheritance, be it the rainforests of the Amazon or the chemical composition of the atmosphere. Rather, these solutions will be: large central station power technologies that can meet the energy needs of billions of people increasingly living in the dense mega-cities of the global south without emitting carbon dioxide, further intensification of industrial scale agriculture to meet the nutritional needs of a population that is not only growing but eating higher up the food chain, and a whole suite of new agricultural, desalinization and other technologies for gardening planet Earth that might allow us not only to pull back from forests and other threatened ecosystems but also to create new ones. The New Ecological Politics The great ecological challenges that our generation faces demands an ecological politics that is **generative, not restrictive.** An ecological politics capable of addressing global warming will require us to reexamine virtually every prominent strand of post-war green ideology. From Paul Erlich's warnings of a population bomb to The Club of Rome's "Limits to Growth," contemporary ecological politics have consistently embraced green Malthusianism despite the fact that the Malthusian premise has persistently failed for the better part of three centuries. Indeed, the green revolution was exponentially increasing agricultural yields at the very moment that Erlich was predicting mass starvation and the serial predictions of peak oil and various others resource collapses that have followed have continue to fail. This does not mean that Malthusian outcomes are impossible, but neither are they inevitable. **We do have a choice** in the matter, but it is not the choice that greens have long imagined. The choice that humanity faces is not whether to constrain our growth, development, and aspirations or die. It is whether we will continue to innovate and accelerate technological progress in order to thrive. Human **technology and ingenuity have repeatedly confounded Malthusian predictions** yet green ideology continues to cast a suspect eye towards the very technologies that have allowed us to avoid resource and ecological catastrophes. But such solutions will require environmentalists to abandon the "small is beautiful" ethic that has also characterized environmental thought since the 1960's. We, the most secure, affluent, and thoroughly modern human beings to have ever lived upon the planet, must abandon both the dark, zero-sum Malthusian visions and the idealized and nostalgic fantasies for a simpler, more bucolic past in which humans lived in harmony with Nature.

**2AC—Rodriguez**

**Anti-blackness isn’t a monolithic root cause.**

**Shelby 7** – Tommie Shelby, Professor of African and African American Studies and of Philosophy at Harvard, 2007, We Who Are Dark: The Philosophical Foundations of Black Solidarity

**Others** might **challenge the distinction between** **ideological and structural causes of black disadvantage**, on the grounds that **we are rarely**, if ever, **able to** so **neatly separate these factors**, an epistemic situation that is only made worse by the fact that these causes interact in complex ways with behavioral factors. These distinctions, while perhaps straightforward in the abstract, are difficult to employ in practice. For example, **it would be** difficult, if not **impossible**, **for the members of a poor black community to determine** **with any accuracy** **whether their impoverished condition is due** **primarily to institutional racism**, the impact of past racial injustice, **the increasing technological basis of the economy**, **shrinking state budgets**, the vicissitudes of **world trade**, the ascendancy of **conservative ideology**, **poorly funded schools**, lack of personal initiative, **a violent drug trade** that deters business investment, **some combination of these factors**, **or some other explanation altogether**. Moreover, it is notoriously difficult to determine when the formulation of putatively race-neutral policies has been motivated by racism or when such policies are unfairly applied by racially biased public officials.¶ **There are** very real **empirical difficulties** **in determining the** **specific causal significance** **of the factors that create and perpetuate black disadvantage**; nonetheless, it is clear that these factors exist and that **justice will demand** **different practical remedies according to** **each factor's relative impact** **on blacks' life chances**. **We must acknowledge that our social world is complicated** and not immediately transparent to common sense, **and thus that** **systematic empirical inquiry**, **historical studies, and rigorous social analysis are required to reveal its systemic structure** and sociocultural dynamics. There is, moreover, no mechanical or infallible procedure for determining which analyses are the soundest ones. In addition, given the inevitable bias that attends social inquiry, legislators and those they represent cannot simply defer to social-scientific experts. **We must instead rely on** **open public debate**—among politicians, scholars, policy makers, intellectuals, and ordinary citizens—**with the aim of garnering** **rationally motivated** and informed **consensus**. And even if our practical decision procedures rest on critical deliberative discourse and thus live up to our highest democratic ideals, some trial and error through actual practice is unavoidable.¶ These difficulties and complications notwithstanding, a general recognition of the distinctions among the ideological and structural causes of black disadvantage could help blacks refocus their political energies and self-help strategies. **Attention to these distinctions might help** **expose the superficiality of theories** **that seek to** **reduce all the social obstacles that blacks face to** contemporary forms of racism or **white supremacy**. **A more** penetrating, **subtle, and empirically grounded** **analysis** **is needed to** **comprehend the causes of racial inequality and black disadvantage**. Indeed, these distinctions highlight the necessity to probe deeper to find the causes of contemporary forms of racism, as some **racial conflict may be a symptom of broader problems or recent social developments** (**such as immigration policy** or reduced federal funding for higher education).

**2AC—Wilderson**

#### Blacks aren’t ontologically dead and Wilderson offers no alternative.

SAËR MATY BÂ, teaches film at Portsmouth University, September 2011 "The US Decentred: From Black Social Death to Cultural Transformation" book review of Red, Black & White: Cinema and the Structure of US Antagonisms and Mama Africa: Reinventing Blackness in Bahia, Cultural Studies Review volume 17 number 2 http://epress.lib.uts.edu.au/journals/index.php/csrj/index pp. 381–91

Red, White and Black is particularly undermined by Wilderson’s propensity for exaggeration and blinkeredness. In chapter nine, ‘“Savage” Negrophobia’, he writes:¶ The philosophical anxiety of Skins is all too aware that through the Middle Passage, African culture became Black ‘style’ ... Blackness can be placed and displaced with limitless frequency and across untold territories, by whoever so chooses. Most important, there is nothing real Black people can do to either check or direct this process ... Anyone can say ‘nigger’¶ because anyone can be a ‘nigger’. (235)7¶ Similarly, in chapter ten, ‘A Crisis in the Commons’, Wilderson addresses the issue of ‘Black time’. Black is irredeemable, he argues, because, at no time in history had it been deemed, or deemed through the right historical moment and place. In other words, the black moment and place are not right because they are ‘the ship hold of the Middle Passage’: ‘the most coherent temporality ever deemed as Black time’ but also ‘the “moment” of no time at all on the map of no place at all’. (279)¶ Not only does Pinho’s more mature analysis expose this point as preposterous (see below), I also wonder what Wilderson makes of the countless historians’ and sociologists’ works on slave ships, shipboard insurrections and/during the Middle Passage,8 or of groundbreaking jazz‐studies books on cross‐cultural dialogue like The Other Side of Nowhere (2004). Nowhere has another side, but once Wilderson theorises blacks as socially and ontologically dead while dismissing jazz as ‘belonging nowhere and to no one, simply there for the taking’, (225) there seems to be no way back. It is therefore hardly surprising that Wilderson ducks the need to provide a solution or alternative to both his sustained bashing of blacks and anti‐ Blackness.9 Last but not least, Red, White and Black ends like a badly plugged announcement of a bad Hollywood film’s badly planned sequel: ‘How does one deconstruct life? Who would benefit from such an undertaking? The coffle approaches with its answers in tow.’ (340)

**2AC—Social Death**

**No social death – history proves**

**Brown 9** Vincent, Prof. of History and African and African-American Studies @ Harvard Univ., December, "Social Death and Political Life in the Study of Slavery," American Historical Review, p. 1231-1249

THE PREMISE OF ORLANDO PATTERSON’S MAJOR WORK, that enslaved Africans were natally alienated and culturally isolated, was challenged even before he published his influential thesis, primarily by scholars concerned with “survivals” or “retentions” of African culture and by historians of slave resistance. In the early to mid-twentieth century, when Robert Park’s view of “the Negro” predominated among scholars, it was generally assumed that the slave trade and slavery had denuded black people of any ancestral heritage from Africa. The historians Carter G. Woodson and W. E. B. Du Bois and the anthropologist Melville J. Herskovits argued the opposite. Their research supported the conclusion that while enslaved Africans could not have brought intact social, political, and religious institutions with them to the Americas, they did maintain significant aspects of their cultural backgrounds.32 Herskovits ex- amined “Africanisms”—any practices that seemed to be identifiably African—as useful symbols of cultural survival that would help him to analyze change and continuity in African American culture.33 He engaged in one of his most heated scholarly disputes with the sociologist E. Franklin Frazier, a student of Park’s, who empha- sized the damage wrought by slavery on black families and folkways.34 More recently, a number of scholars have built on Herskovits’s line of thought, enhancing our understanding of African history during the era of the slave trade. Their studies have evolved productively from assertions about general cultural heritage into more precise demonstrations of the continuity of worldviews, categories of belonging, and social practices from Africa to America. For these scholars, the preservation of distinctive cultural forms has served as an index both of a resilient social personhood, or identity, and of resistance to slavery itself. 35¶ Scholars of slave resistance have never had much use for the concept of social death. The early efforts of writers such as Herbert Aptheker aimed to derail the popular notion that American slavery had been a civilizing institution threatened by “slave crime.”36 Soon after, studies of slave revolts and conspiracies advocated the idea that resistance demonstrated the basic humanity and intractable will of the enslaved—indeed, they often equated acts of will with humanity itself. As these writ- ers turned toward more detailed analyses of the causes, strategies, and tactics of slave revolts in the context of the social relations of slavery, they had trouble squaring abstract characterizations of “the slave” with what they were learning about the en- slaved.37 Michael Craton, who authored Testing the Chains: Resistance to Slavery in the British West Indies, was an early critic of Slavery and Social Death, protesting that what was known about chattel bondage in the Americas did not confirm Patterson’s definition of slavery. “If slaves were in fact ‘generally dishonored,’ ” Craton asked, “how does he explain the degrees of rank found among all groups of slaves—that is, the scale of ‘reputation’ and authority accorded, or at least acknowledged, by slave and master alike?” How could they have formed the fragile families documented by social historians if they had been “natally alienated” by definition? Finally, and per- haps most tellingly, if slaves had been uniformly subjected to “permanent violent domination,” they could not have revolted as often as they did or shown the “varied manifestations of their resistance” that so frustrated masters and compromised their power, sometimes “fatally.”38 The dynamics of social control and slave resistance falsified Patterson’s description of slavery even as the tenacity of African culture showed that enslaved men, women, and children had arrived in the Americas bearing much more than their “tropical temperament.”¶ The cultural continuity and resistance schools of thought come together pow- erfully in an important book by Walter C. Rucker, The River Flows On: Black Re- sistance, Culture, and Identity Formation in Early America. In Rucker’s analysis of slave revolts, conspiracies, and daily recalcitrance, African concepts, values, and cul- tural metaphors play the central role. Unlike Smallwood and Hartman, for whom “the rupture was the story” of slavery, Rucker aims to reveal the “perseverance of African culture even among second, third, and fourth generation creoles.”39 He looks again at some familiar events in North America—New York City’s 1712 Coromantee revolt and 1741 conspiracy, the 1739 Stono rebellion in South Carolina, as well as the plots, schemes, and insurgencies of Gabriel Prosser, Denmark Vesey, and Nat Turner—deftly teasing out the African origins of many of the attitudes and actions of the black rebels. Rucker outlines how the transformation of a “shared cultural heritage” that shaped collective action against slavery corresponded to the “various steps Africans made in the process of becoming ‘African American’ in culture, orientation, and identity.”40

**2AC—Method**

**Methodological assessments aren’t a prior question.**

**Light 5** (Andrew, Environmental Philosophy @ NYU, “What is Pragmatic Philosophy”, http://faculty.washington.edu/alight/papers/Light.What%20Pragmatic.pdf. P. 349-351)

I have no easy answer to this question of how practical or “do-able” reform proposals made by philosophers should be. As suggested above, it is a question that has obvious important implications for the application of philosophical principles to environmental policy. My intuition though is that the pragmatist ought to have a long-term end in view while at the same time she must have at the ready **viable alternatives** which **assume** current **political** or **economic** systems and structures whenever possible. This is not to say that the pragmatic philosopher gives up on the tasks of defending alternatives to current structures, and the pursuit of those alternatives in democratic debates on the reallocation of resources. It only means that our position may require, for consistency sake to our pragmatic intentions at least, that we not rely exclusively on such changes in articulating our preferred ends for better public policies. In this context, there are at least two senses in which one could understand the meaning of “pragmatic” philosophy as discussed so far. (1) Philosophy that has practical intent, anchored to practical problems, and (2) Philosophy which aids in the development of policy solutions that can actually achieve support and consensus. While Young’s approach certainly encompasses (1) the question is whether she also does (2). My own pragmatist approach assumes that there is a connection between (1) and (2) (indeed, that (1) implies (2)). Assuming a successful argument that (1) and (2) are related in this way (for some this may take some argument, for others it will be obvious) then a question remains concerning how to go about achieving (2). Let me make just one suggestion for how the pragmatist could go about reconciling her desire to change systems with the need to make achievable policy recommendations. As is suggested by my approach, my view is that if a pragmatic philosophy in the end is in the service of an argument to create **better polices**, then in our democratic society it must be prepared to argue its case before the public, and perhaps sometimes only before policy makers. As Said puts it, the public intellectual not only wants to express her beliefs but also wants to persuade others—meaning the public at large—of her views (1994, p. 12). This raises the critical issue of how such appeals to the public are to be made. It raises the issue of how important persuasion is to the creation of pragmatic arguments. All philosophy is in some sense about persuasion, though to differentiate ourselves from rhetoricians (if we are interested in making such distinctions, which I still am) we must restrict ourselves to persuasion through some form of argument given more or less agreed upon (and revisable) standards for what counts as a good argument. But the pragmatic philosopher is not simply concerned with per- suading other philosophers. She is also interested in persuading the public either directly (in hopes that they will in turn influence policy makers) or indirectly, by appealling to policy makers who in turn help to shape public opinion. The work of a public philosophy is not solely for intramural philosophical discussion; it is aimed at larger forums. But as I suggested before, such a task requires some attention to the question of what motivates either the public, policy makers, or both to act. Our bar is set higher than traditional philosophical standards of validity and abstractly conceived soundness. For if we are to direct our philosophy at policies in a context other than a hypothetical philosophical framework, we must also make arguments which will motivate our audiences to act. Since we are dealing in ethi- cal and political matters, the question for pragmatic philosophers like Young and myself is how much we must attend to the issue of moral motivation in forming our pragmatic arguments. If we agree that the issue of moral motivation is always crucial for a pragmatic philosophy then at least two issues arise. First, as I suggested before, we must be prepared to embrace a theoretical or conceptual pluralism which allows us to **pick and choose** from a **range of conceptual frameworks** in making our arguments **without committing** to the **theoretical monism** which may be assumed in some versions of these frameworks. The reason is that we need to be able to make arguments that will appeal to the conceptual frameworks of our audiences while recognizing that these frameworks can change from **audience to audience**. So, if we think a utilitarian argument will be useful for talking to economists in decision making positions, then we should be allowed to engage such a framework without completely committing ourselves to utilitarianism.

## \*\*\* 1AR

### Case

#### SMRs are safe and more economical.

**Szondy 12** (David, Freelance writer and frequent contributor to Gizmag, *Small modular nuclear reactors - the future of energy?*, February 16th, http://www.gizmag.com/small-modular-nuclear-reactors/20860/)

One way of **getting around** many of **these problems** is through the development of small modular reactors (SMR). These are reactors capable of generating about 300 megawatts of power or less, which is enough to run 45,000 US homes. Though small, SMRs are proper reactors. They are quite different from the radio-thermal generators (RTG) used in spacecraft and remote lighthouses in Siberia. Nuclear reactors such as SMRs use controlled nuclear fission to generate power while RTGs use natural radioactive decay to power a relatively simple thermoelectric generator that can only produce, at most, about two kilowatts.

In terms of power, RTGs are the equivalent of batteries while small nuclear reactors are only "small" when compared to conventional reactors. They are hardly the sort that you would keep in the garage. In reality, SMR power plants would cover the area of a small shopping mall. Still, such an installation is not very large as power plants go and a reactor that only produces 300 megawatts may not seem worth the investment, but the US Department of Energy is offering US$452 million in matching grants to develop SMRs and private investors like the Bill Gates Foundation and the company of Babcock and Wilcox are putting up money for their own modular reactor projects.

The 60-year old breakthrough

One reason for government and private industry to take an interest in SMRs is that they've been **successfully employed** for much longer than most people realize. In fact, hundreds have been steaming around the world inside the hulls of nuclear submarines and other warships for sixty years. They've also been used in merchant ships, icebreakers and as research and medical isotope reactors at universities. There was even one installed in the Antarctic at McMurdo Station from 1962 to 1972. Now they're being considered for domestic use.

The case for SMRs

SMRs have a **number of advantages** over conventional reactors. For one thing, SMRs are cheaper to construct and run. This makes them very attractive to poorer, energy-starved countries; small, growing communities that don't require a full-scale plant; and remote locations such as mines or desalination plants. Part of the reason for this is simply that the reactors are smaller. Another is that, not needing to be custom designed in each case, the reactors can be standardized and some types built in factories that are able to employ economies of scale. The factory-built aspect is also important because a factory is more efficient than on-site construction by as much as eight to one in terms of building time. Factory construction also allows SMRs to be built, delivered to the site, and then returned to the factory for dismantling at the end of their service lives - eliminating a major problem with old conventional reactors, i.e. how to dispose of them.

SMRs also enjoy a good deal of design flexibility. Conventional reactors are usually cooled by water - a great deal of water - which means that the reactors need to be situated near rivers or coastlines. SMRs, on the other hand, can be cooled by air, gas, low-melting point metals or salt. This means that SMRs can be placed in remote, inland areas where it isn't possible to site conventional reactors.

Safety

This cooling system is often passive. In other words, it relies more on the natural circulation of the cooling medium within the reactor's containment flask than on pumps. This passive cooling is one of the ways that SMRs can improve safety. Because modular reactors are smaller than conventional ones, they contain less fuel. This means that there's less of a mass to be affected if an accident occurs. If one does happen, there's less radioactive material that can be released into the environment and makes it easier to design emergency systems. Since they are smaller and use less fuel, they are easier to cool effectively, which greatly reduces the likelihood of a catastrophic accident or meltdown in the first place.

This also means that accidents proceed much slower in modular reactors than in conventional ones. Where the latter need accident responses in a matter of hours or minutes, SMRs can be responded to in hours or days, which reduces the chances of an accident resulting in major damage to the reactor elements.

The SMR designs that reject water cooling in favor of gas, metal or salt have their own safety advantages. Unlike water-cooled reactors, these media operate at a lower pressure. One of the hazards of water cooling is that a cracked pipe or a damaged seal can blow radioactive gases out like anti-freeze out of an overheated car radiator. With low-pressure media, there's less force to push gases out and there's less stress placed on the containment vessel. It also eliminates one of the frightening episodes of the Fukushima accident where the water in the vessel broke down into hydrogen and oxygen and then exploded.

Another advantage of modular design is that some SMRs are small enough to be installed below ground. That is cheaper, faster to construct and less invasive than building a reinforced concrete containment dome. There is also the point that putting a reactor in the ground makes it less vulnerable to earthquakes. Underground installations make modular reactors easier to secure and install in a much smaller footprint. This makes SMRs particularly attractive to military customers who need to build power plants for bases quickly. Underground installation also enhances security with fewer sophisticated systems needed, which also helps bring down costs.

SMRs can help with proliferation, nuclear waste and fuel supply issues because, while some modular reactors are based on conventional pressurized water reactors and burn enhanced uranium, others use less conventional fuels. Some, for example, can generate power from what is now regarded as "waste", burning depleted uranium and plutonium left over from conventional reactors. Depleted uranium is basically U-238 from which the fissible U-235 has been consumed. It's also much more abundant in nature than U-235, which has the potential of providing the world with energy for thousands of years. Other reactor designs don't even use uranium. Instead, they use thorium. This fuel is also incredibly abundant, is easy to process for use as fuel and has the added bonus of being utterly useless for making weapons, so it can provide power even to areas where security concerns have been raised.

But there's still the sticking point that modular reactors are, by definition, small. That may be fine for a submarine or the South Pole, but what about places that need more? Is the alternative conventional nuclear plants? It turns out that the answer is no. Modular reactors don't need to be used singly. They can be set up in batteries of five or six or even more, providing as much power as an area needs. And if one unit needs to be taken off line for repairs or even replacement, it needn't interfere with the operation of the others.

#### Speed of warming prevents adaptation.

**Washington 11** (Haydn and John Cook, An environmental scientist of 35 years’ experience. His PhD ‘The Wilderness Knot’ was in social ecology \*\* the Climate Communication Fellow for the Global Change Institute at the University of Queensland. He studied physics at the University of Queensland, Australia. After the graduating, he majored in solar physics in his post-grad honors year and created the website skepticalscience.com, Climate Change Denial: Heads in the Sand, Published in 2011 by Earthscan, Page 34)

The next concern is the **speed of change** involved in human-caused climate change, which is thought to be happening at a much faster rate than that of previous climate changes, some of which took thousands of years (Houghton, 2008). The difference between the last ice age and today was about five degrees Celsius, and this warming happened over 10,000 years. This is 0.05 degrees per century. In contrast, the observed rate of warming over the last 50 years is .7 degrees Celsius (and another .6 degrees is in the pipeline, making this 1.3 degrees) and the estimated rate for the next century is more than five degrees, which is 100 times faster than the last glaciations (Pittock, 2009). It is one thing to adapt to changed climate over 10,000 years, but a **very different** thing to adapt over 100 years. Most plant species cannot migrate faster than one kilometer a year (Houghton, 2008). It is this fast speed of change on the world’s already stressed ecosystems (MA, 2005) that is likely to lead to major species extinction. The IPCC (2007) considered the effects of what increased temperature might be. Mark Lynas (2007) has

#### US has to act first is key to motivate China and India

Hansen, 9—best known for bringing global warming to the world’s attention in the 1980s, when he first testified before Congress. An adjunct professor in the Department of Earth and Environmental Sciences at Columbia University and at Columbia’s Earth Institute, and director of the NASA Goddard Institute for Space Studies, he is frequently called to testify before Congress on climate issues. (James, Storms of My Grandchildren, 2009, Published by Bloomsbury, Pg. 296-297)

Bill: There are also a lot of people who say that it doesn't matter what the United States does, because China now has the greatest emissions and its emissions are growing the fastest. Jim: China is taking the right steps to move toward carbon-free energy. They are now number one in the world in production of clean energy technologies: solar power, wind power, and nuclear power. Also, China stands to suffer greatly from global climate change because China has several hundred million people living near sea level and the country is already experiencing large damaging regional climate disasters. There is no doubt that China will want to move rapidly toward clean carbon-free energies. When the United States realizes that it must impose an internal fee on carbon emissions, it should not be difficult to get China to agree to do the same. Also, it is important to recognize that the United States is responsible for three times more of the excess [humanmade] carbon dioxide in the air today than any other nation, with China being second. The much greater responsibility for accumulated humanmade emissions is true despite the fact that China's population is three times greater than the United States’. So there is no reason to expect China to act first to reduce emissions. However, there are advantages in beginning to act rapidly. China is investing heavily in clean energies, and it is likely that they will recognize the merits of imposing an internal carbon price to spur development and implementation of clean energies. The United States risks becoming second-class technologically and economically this century if it does not stop subsidizing dirty technologies and instead move toward progressive policies such as fee and green check, which will stimulate development of clean energies.